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ABSTRACT

The document, one in a series to assist in planning procedures for local and State vocational agencies, describes two computer programs, COMENR and VOCEDENR, to be used in secondary enrollment forecasts. The steps in the procedure are: 1) gather data on past public enrollment, new housing trends, census data, and current vocational enrollments and feed them into the computer; 2) the computer yields estimates of public school secondary and vocational enrollment by grade and year; 3) the output is evaluted and an estimate of intersystem transfers and institutional enrollment is added; 4) the new data is fed into the computer; and 5) the computer reforecasts and projects enrollment five years into the future. The manual covers the administrative procedures for collecting and processing the data. The program COMENR is for community enrollment forecasting. The program VOCEDENR is for vocational education enrollment forecasting. (AG)

A Vocational Education Planning System
FOR LOCAL SCHOOL DISTRICTS

NEW JERSEY STATE DEPARTMENT OF EDUCATION
DIVISION OF VOCATIONAL EDUCATION
225 WEST STATE STREET
TRENTON, N.J. 08625

with the assistance of
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ENROLLMENT FORECASTING PROCEDURES

Vol. V

A VOCATIONAL EDUCATION PLANNING SYSTEM
FOR
LOCAL SCHOOL DISTRICTS

Volume V: Enrollment Forecasting Procedures

Produced For

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Linden

Lower Camden County Regional
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July 1970 - June 1973

Acknowledgments

The Division of Vocational Education of the New Jersey State Department of Education has long recognized the need to introduce more science into the art of educational planning. This publication is an outgrowth of its efforts to devise more systematic, objective, and precise bases for program decisions. The Division has determined, moreover, that the key to the success of its system is to insure that the Local Education Agency has an advanced planning capability.

Grateful acknowledgment is given to Dr. Robert M. Worthington, former Assistant Commissioner of Education (DVE), for initiating this study and to Mr. Stephen Poliacik, Assistant Commissioner of Education (DVE), for his guidance and support in continuing the study when problems seemed insurmountable. Also, to Former Commissioner of Education, Dr. Carl L. Marburger, and Acting Commissioner of Education, Dr. Edward W. Kilpatrick for their support and patience. Appreciation is further expressed to the Superintendents of the five LEAs: Mr. Charles A. Boyle, Edison; Mr. Americo R. Taranto, Linden; Mr. Joseph R. Wilson, Somerset; Mr. Leonard A. Westman; Lower Camden County Regional High School; and Dr. J. Henry Zanzalari, Middlesex County Vocational Schools and Technical Institute for their cooperation and understanding.

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The principal author of Volume V is:

Arnold R. Post

Series Preface

Planning is a universal concept based on the proposition that if you think a bit about what you intend to do, you are likely to do whatever it is better than if you don't think about it. This process of thinking ahead generally involves gathering information, analyzing the information and then formulating one or more courses of action to follow. The planning system presented here embodies these elements in operational procedures for planning for school districts.

The Vocational Education Planning System for Local School Districts draws heavily upon a growing body of experience in educational planning which has been generated by Government Studies & Systems (GSS). The introduction describes these concepts. Out of this experience has evolved a set of planning techniques, particularly suited by design and through actual use, to enable effective planning. The bases for and uses of indicators, planning factors, forecasts, models and others of these techniques are clearly laid out in this manual as they appear in the normal course of the planning cycle.

This manual is one of several resulting from a project to design planning procedures for local and state vocational education agencies. This manual describes the overall planning process for LEAs. It is to be used in conjunction with the following manuals:

Volume I:	Local Education Agency Users' Manual
Volume II:	Local Education Agency Users' Data Collection Manual
Volume III:	Local Education Agency Planning Analyst's Procedures
Volume IV:	State Application Funding Procedures
Volume V:	Enrollment Forecasting Procedures
Volume VI:	Procedures for Estimating Adult and Post-Secondary Potential Enrollment
Volume VII:	Job Demand Forecasting Program
Volume VIII:	Training Materials
Volume IX:	Guide to Project Manuals

The most important ingredients in effective planning, however, are the people who do the planning. The planning team itself should include, at the very least, those who are going to be directly responsible for the execution of the plan, once developed, and those who are otherwise directly affected by the plan. People who participate in the planning process, who see their input take shape in a plan, tend to be better advocates and implementors of that plan.

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GLOSSARY

The Glossary which follows is provided so that readers will know meanings of special terms used in this report. Some terms will be familiar, but some are statistical terms not common to anyone except statisticians. We have tried to keep technical language to a minimum, although in some sections it was necessary to use a certain amount of statistical terminology.

Age Distribution - the number of people in each age group among the total population.

Base Case - expectation of what will happen in the future if the present school programs and staffing policy remain in effect.

COMENR - community enrollment forecaster computer program which yields prospective public secondary school enrollment by grade and year for a district.

Community Development - new housing.

Community Enrollment - students enrolled in all types of schools --public, private, parochial--within a particular school district.

Entry Status - the year at which students are expected to enter the school district for which a forecast is being prepared.

EPS - (educational planning system) an analysis process (in part computerized) yielding among other things the base case analysis.

Grade Retention Ratio - same as "succession rate."

Input - information entered into computer.

Output - information from computer.

Override - new or judgmental data put into computer after initial run to adjust the final enrollment forecast (override data is usually supplied by LEA staff).

Persistence Rate - the number of people in household units in year n+1 who were in those units in year n.

Printout - printed data from computer.

Run - computer processing and printout of data.

Sending District - the school district transferring students into school district for which a forecast is being prepared.

Service Time Distribution - number of years, on the average, a student remains within a given school or district service area.

Standard Deviation - a technical term, in general use among statisticians, meaning a measure of the spread of the data about the average, (technically the square root of the variance).

Student Intentions File - information from students on their next and future year's plans in regard to program selection.

Succession Rate - also called retention ratio or survival ratio, meaning if there are s students in a grade this year and n is the number of those students who are in the next higher grade (in the same school) next year then n/s is the succession rate.

Example

year	70-71	71-72
grade	9	10
students	100	90

then succession rate = 0.9

(from same school)

The Model - the enrollment forecasting plan, in whole or in part, depending on context (used rather loosely).

Tolerable Forecast Error - the level of error within which it is possible to forecast realistically, and beyond which accurate forecasting could not be done.

Transfer Rate - the number of students transferring from a sending school to the school district being projected.

Type of Student or Student Type - a breakdown of students into categories: handicapped, disadvantaged, gifted, regular.

VOCEDENR - a computer program which will yield a first estimate of prospective public school vocational-education enrollment by school grade, year, voc-ed program, area and type of student.

Weighted, Weighting - making some information have more significance than other in the model, for example, more recent information is given heavier weight in the analysis than older information.

SECTION I

INTRODUCTION

Introduction

Enrollment forecasting, the art of predicting the number of students who will attend a given school in a given year, is familiar to every school administrator. It is a most necessary ingredient in all planning for educational facilities. Clearly the objective is to come up with a figure as close as possible to actual enrollment so that advance planning will be knowledgeable and realistic. The method of enrollment forecasting described here will enable administrators to reach this objective more accurately than in the past, and, further, will enable them to plan realistically five years in advance.

Secondary Enrollment Forecasting is only one part, although an important one, of the New Jersey Vocational Education Planning System Project, which has been prepared by Government Studies & Systems, Inc. The overall project includes design, implementation, production of user manuals, training materials, forecasters, for use by both state and local vocational education agencies.

While this report is directed specifically towards secondary enrollment forecasts for the New Jersey Vocational Education Planning System Project, the forecasting method obviously has general application for forecasting overall enrollment, or for any particular enrollment needed.

To use this enrollment forecaster for the first time requires an initial information-gathering effort by school administrators and staff. The administrators will be adding their judgments on the data. Gathering the data and coming up with an estimate of enrollment and the judgments will go like this: 1) past public enrollment, new-housing trends, census data, and current vocational enrollments will be fed into the computer; 2) the computer will yield estimates of public school secondary and vocational enrollment by grade and year; 3) the LEA staff will evaluate this output and add its estimate of intersystem transfers and non-household (institutional) enrollment; 4) LEA returns the corrected and judgmental data to the computer; 5) the computer reforecasts using the new data and comes up with a closer enrollment for five years into the future.

After the initial information-gathering is completed, the job will then be to feed the computer updated information. The computer will then, taking into account past and future projections and new situations, turn out predictions, thereby freeing admininstrators from this task and enabling planning officials to get a better overall picture of educational needs.

This manual covers the administrative procedures for collecting and processing of data. Most LEA's have procedures already established for similar purposes. The procedures introduced here are to be interpreted as suggestions for modifying or augmenting the existing procedures.

The General Forecasting Scheme

One of the most important factors in five-year enrollment forecasting is new housing planned for the area being forecast. New housing directly effects population figures. Therefore the number of new units to be built must be known as accurately as possible in order to predict enrollment.

SECTION II

OVERVIEW OF PROGRAMS

Since the distribution of enrollment by grade correlates closely with the distribution by population by age, it is possible to develop enrollment estimates by grade on the basis of expected new housing in the school district.

Public school enrollment constitutes only a part, although the largest part, of most district's school enrollment. Private and parochial school enrollments, and student transfers to or from public or private or parochial schools must be taken into account. Much of the uncertainty involved in estimating future public school enrollment results from the variability of such transfers.

This enrollment forecaster prepares estimates of recent intersystem transfers primarily on the assumption that both public and non-public enrollments will grow or decline at equal rates subject to the pattern of new housing. This assumption is reasonable in districts where new housing is potentially of major importance. Its usefulness in areas where this is not true has not been explored.

Description of Computer Programs

The flow chart on the next page, Figure 1, shows how the secondary level enrollment forecaster operates. The community enrollment forecaster (COMENR) requires three groups of information each year for its initial run: 1) how many new housing units were authorized by municipal officials the previous year, 2) how many net resident births occurred within the LEA's jurisdiction, 3) active enrollment by grade K-12 and post-graduate as of March 31. Active enrollment here means LEA area resident, non-tuition, non-institution students attending public schools which feed the LEA schools.

COMENR first generates an estimate of annual housing increases, using historical data from the previous year's output. This estimate is then combined with the most recent community age distribution estimate in order to estimate increases or decreases in school age population (5-19 years old). From this estimate a forecast of enrollment by grade which is consistent with the housing trend is derived.

The next step COMENR takes is to assume that, in the absence of intersystem student transfers, enrollment in both public and non-public school systems would change in proportion to changes in the community's age distribution, induced by changes in the housing supply. Any past divergence of actual public school enrollment from this assumption (including divergences due to statistical bias) is attributed to intersystem student transfers. Estimates of intersystem transfers are then printed out by grade and year. COMENR calculates a weighted average estimate of

Forecasting Activities
Schematic Summary

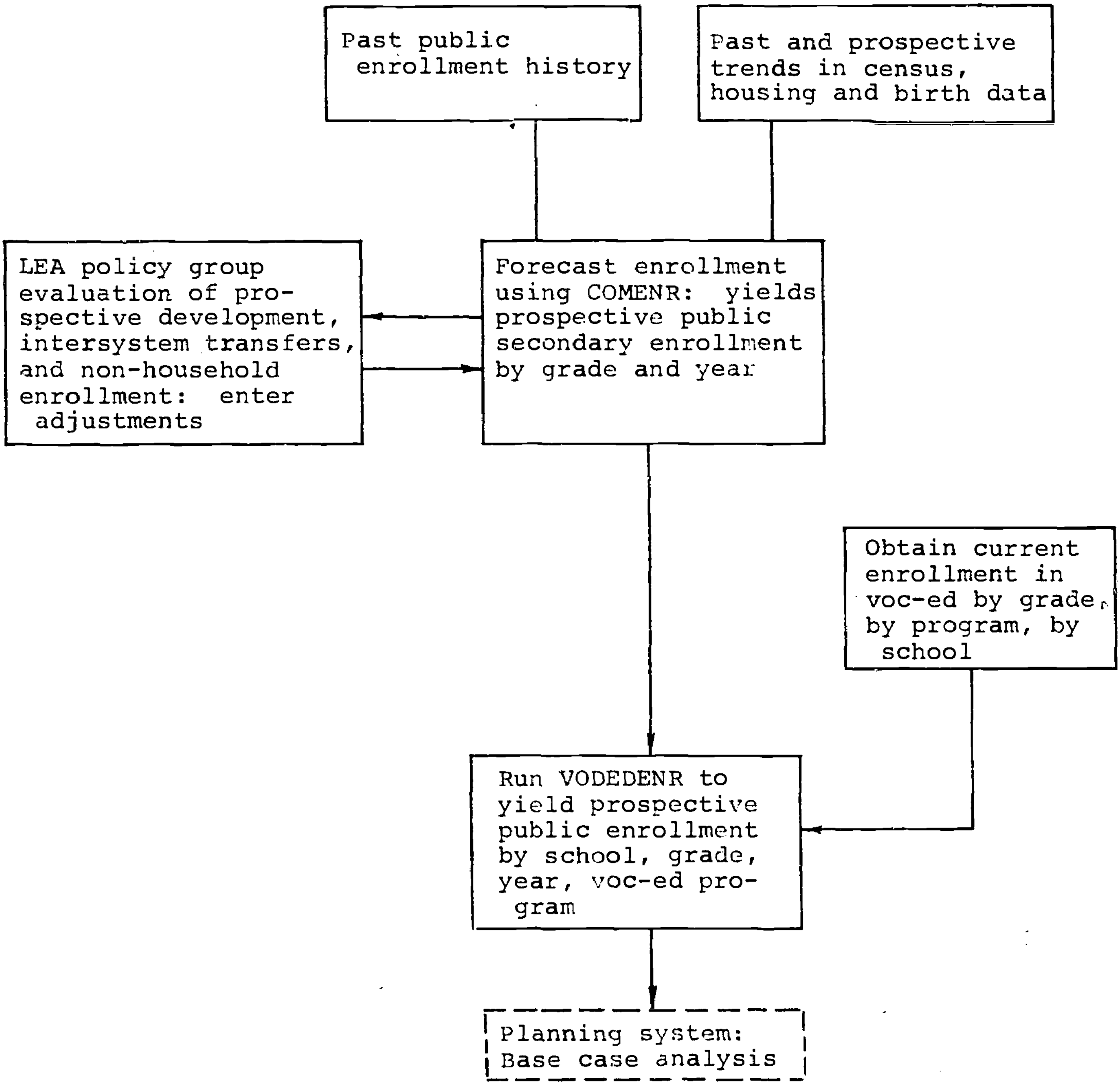


Figure 1

transfers, with weighting arranged to make past year data four times as significant as four-year-old data.

The standard deviation of transfers by grade is calculated about the weighted averages; and a tolerable forecast error is calculated as plus or minus twice these standard deviations. In the data explored so far, this range of error is adequate to include all the variations observed. The tolerable forecast error has been approximately 2 percent of public school enrollment at the secondary level (grades 7-12, in the aggregate). The public school percentage of total community enrollment is also printed out by grade and year.

Outputs are discussed in detail in the next section of this document.

(The final printed output is a set of index numbers by which the actual September enrollments, when known, can be extended to yield estimated grade 9-12 enrollment for the next five years.)

This enrollment estimate is subject to LEA satisfaction that the COMENR assumptions on housing growth, intersystem transfers, and tuition and institutional enrollments are realistic. Staff can provide override information on these items, and COMENR can be run until all appropriate assumptions are incorporated. (When final September 30 enrollment figures are entered, the program will extend them according to the given set of index numbers to yield a final estimate of fall enrollment by grade and year for the entire district.)

The next program, VOCEDENR, produces estimates of enrollment by grade, year, voc-ed program in vocational courses. This is done for each school and summed for the LEA district as a whole.

Figure 2 is a more detailed flow of the process.

Particularizing the General Scheme

The model deals with five age groups: births, 0-4, 5-9, 10-14, and 14-19. An assumption is made that population changes due to changes in the number of households are evenly distributed within five-year age groups. Thus, if one hundred students aged 10-14 years old are expected to arrive in the community as a result of new housing, it is assumed that twenty of them will be 10 years old, twenty will be 11 years old and so on. Another assumption made is that various statewide statistical averages apply to each district.

The enrollment estimate is based on reported housing and birth information for the previous year, estimates of new housing for current and future years, and an average allowance for intersystem student transfers.

The enrollment forecaster is first run in August. This run estimates enrollment for April of the coming year and for five future years. April is chosen since (a) it allows easier coordination with census data (the census is taken in April), (b) it represents a good average level between September and June. (Enrollment tends to decline over the year.) When actual September enrollment figures for the current year are available, they are compared to the August run (April forecast), the LEA reviews the run and the actual enrollment figures and other actual data, and then stipulates changes, if necessary.

To assure the relevance of the forecast, the LEA should:

Overall Flow

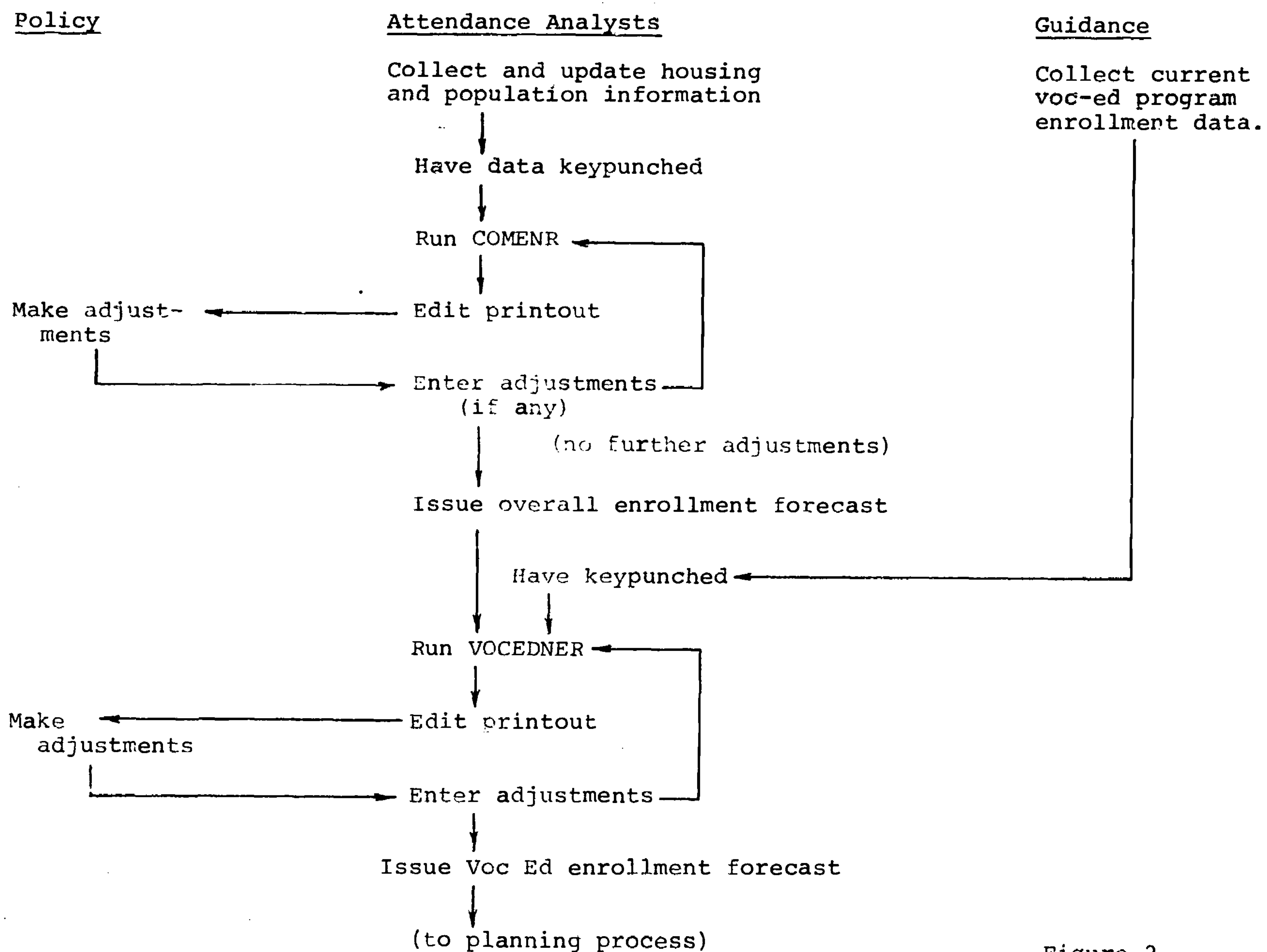


Figure 2

-Compare the housing trend in the forecast with reports of actual building activity since the beginning of the year and with ascertained plans of major builders in the district.

-Measure the number of estimated intersystem transfers against non-public school crowding, expansion plans, expected tuition changes, etc.

-Check the number of tuition students from other districts or students from institutions predicted to transfer into the district against actual trends and against a sending agency or district's estimate of how many they expect to transfer.

To assist in these judgments, the computer prints out the bases on which the estimate is reached.

In this model, the estimates of prospective housing growth are designed to be somewhat generous without being unrealistic. The forecasting goal, here, is to be most accurate among those who tend to overestimate.

The model is designed to operate for clusters of municipalities. It is suitable for areas where clusters of municipalities closely approximate school district boundaries, provided that the boundaries have not changed for six years and no changes are expected within the five-year forecast period. If boundaries are changed, two separate computer runs must be made. The reason for using the "cluster of municipalities" boundaries instead of school district boundaries is that the State census information used in the forecasts is obtained by censusing municipalities and not school districts. However, we know of no case in New Jersey where school district boundaries split a municipality, so that the "clusters of municipalities" method should be applicable to all school districts, with possibly a rare exception.

Theoretical Background

The factors affecting public school enrollment are complex. This is why enrollment estimates based on grade retention ratios, the traditional estimating device, are not accurate except in the short run. Such estimates, using only internal data, are highly conditioned by past experience, and fail to take into account important factors in the outside world. The alternative employed here is to relate enrollment forecasts to specific geographic area and its changing conditions.

The demographic model has been named "mobility analysis" and departs from the traditional natural increase, net-migration models in several important respects. In the traditional approach, one assumes that the most recently censused population stays put. Then one calculates what this population would number after a few years if certain birth and death rates prevailed. Final adjustments to account for net migration are then made by using past biases to project into the future. This method does not allow for the variations in fertility of migrating population nor does it provide for migration increases.*

The model employed here initially assumes no new housing in the community, and subsequently adjusts its forecasts to reflect reported or expected changes in the housing supply. This initial assumption allows for both the fertility of migrated population and the tendency of existing population to spread out over wider areas as time goes by. Adjustment for housing supply changes is

*See Appendix A

not difficult, particularly since housing development statistics are generally well reported and available in New Jersey.

References

The rationale for this approach is discussed in Appendix D of Handbook of Statistical Procedures for Projections of Public School Enrollment, available through Superintendent of Documents, Government Printing Office, Washington D.C. 20402, as document HE5.224:24027.

Further discussion is available in the Journal of the American Institute of Planners, November 1969, and the 1969 Proceedings of the American Statistical Association, Social Statistics Section, p.216f.

Since these documents were written, the model employed has been further refined to accommodate housing supply growth in terms of both apartments and single family developments and to incorporate information on births. Without these refinements, accuracy of estimate over the short-run of one to three years with regard to total population has been at the 5 percent level or better in 2/3 of the cases.

SECTION III

DETAILS OF PROGRAMS

COMENR - Description of Output - Refer to example printout at end of the Manual (Section VI)

The critical output appears on page four of the example printout. For an eleven year span, from five years before the current year to five years after, the following are printed:

A. Annual Housing Gain (number of new housing units):
There are two options for producing these figures. One is for the user to do their own forecasting by inputting the figures for all eleven years; this was done in the example case and will be explained in the description of the "override" feature on page two of the printout. The second option is to input the figures for earlier years and let the program do the forecasting. For details on the method of calculation, see the comments in the section of the program listing entitled "Calculate Housing Growth."

B. Community Total Enrollments by Grade:
The first four years of school enrollments for the total community are printed out as they were input by the user, for kindergarten through post-graduate (thirteenth grade). Then follows a printout of the community enrollment by grade-group (e.g., 7-8) for those years, calculated by summing the appropriate enrollment figures. The seven future years' enrollments are projected by the program, taking into account the population expected and other factors. For

details on the calculations, see the section of the programs labelled "Project Community Enrollment from POP and ENROPR Arrays."

C. <u>Public Enrollments by Grade:</u>

As with the community enrollments, the information for the first four years, for kindergarten through post-graduate, is provided by the user and input to the program and the grade-groups are calculated by summing enrollments for appropriate grades. The future years are projected by taking into account the percent of the community enrolled in public schools, "transfer rates" and "succession rates" (see glossary).

The calculations can be found in the section of the program beginning "Calculate Percent Public, Succession Rates and Transfers". The calculations for the kindergarten are done differently than for the other grades. This is because the basic figures are calculated on a diagonal, going down grades and across years, which would leave the kindergarten row undefined. Therefore, the year to year change in enrollment for the kindergarten is calculated on the basis of the year-to-year change in the total community enrollment for kindergarten, taking into account the average transfer rates.

The programs begins by printing out the data which the user has provided as input.

Page one of the example printout shows:

A. Persistence Rates by Age Group:

The age groups referred to are as follows: 1) birth 2) zero-four 3) five-nine 4) ten-fourteen 5) fifteen-nineteen 6) total. The term "persistence rates" refers to the proportion of people in an age group that will still be in residence next year.

B. People Per Added-Household by Age Group:

These figures are also given by the age groups described above. The "Technical Details" section explains how the user is to arrive at these figures.

C. Enrollment Operators by Age-Group Index (1-3):

Enrollment operators is a matrix relating grade enrollment to age group population. Here, figures for three age groups 1) five-nine 2) ten-fourteen 3) fifteen-nineteen are printed out for each grade from kindergarten to post-graduate. Again, the calculations can be found in the "Technical Details" section.

D. CY-2 Population by Age Group:

These are population figures for the year CY-2 (two years before the current year), for each of the six age groups mentioned previously.

E. Community Enrollment by Grade-Index:

These figures are for the first four years of the eleven year span discussed previously. They represent the total number of students enrolled in all the schools of the community, by grade, for each of the years. They are calculated by adding the public school enrollments (obtained from the school business office) to the private school enrollments (usually obtained from the private school agency offices or the State Department of Education).

F. Public Enrollments by Grade Index:

As stated above, these figures, for the first four years, can be obtained from the school business office.

G. New Housing Figures by Year:

These figures are provided by the user for a five year period from seven years before the current year. They are divided, as can be seen in the example printout, into single-family and multi-family housing units. Multi-family refers to apartments, dwellings containing five or more units. Single family refers to all non-apartment housing units or all dwellings with three bedrooms or more. This information can be obtained from the Office of Business Economics of the New Jersey Department of Labor & Industry.

Page Two of the example printout is a continuation of the user provided data.

Housing Supply CY-2: This is the total number of housing units in the community, divided into single-family and multi-family, for the year CY-2.

Housing Projection Rule: For the same year, according to whether the actual number of new housing units is greater or smaller than the expected number, one of two rules for projecting future numbers of housing units is selected. For details on the different methods of calculation, see the section of the program beginning "Determine New Housing Growth." The next two items printed on page two are Expected New Single Family Housing for CY-2 mentioned above and the Actual New Single Family Multi-Family Housing for CY-2. For that same year, the Births for CY-2 are input and printed out on page two. The birth data is obtained from the N.J. Department of Health; birth figures are adjusted to show place of residence rather than place of birth. Net infant death figures are also obtained so that these births will not be taken into account in the future estimates. Both the housing and birth data are reported by county and municipality, so that it is necessary for the LEA to sum up the information for all municipalities in its territory for input to COMENR.

Public Enrollment by Grade-Index for CY-1: As with the previously mentioned four years' public school enrollments, this information, which is for one year before the current year, can be obtained from the schools.

Override Input for New- Housing Figures by Year: This feature is optional. If the user wishes to forecast the number of new housing units for future years, rather than letting the program do it, the word "OVRRIDE--" is punched on a card just following the data card with the public school enrollment for CY-1. This indicates to the computer that the next two cards to follow will contain user supplied estimates of new housing units for the seven year period from the year before the current year (CY-1) to five years after (CY+5), one card for single-family and one card for multi-family units.

For details on the automatic methods of housing projection calculation used in the program, see the section of the program listing beginning "Determine New Housing Growth Rule". The last item on page two of the example printout, also only printed if the override option is used, is a reprint of the new housing data, from seven years before the current year to five years after. This completes the printing of the user input data.

All input data is punched on cards, according to the format specifications in the section of this report entitled "Preparation of Data Inputs", and submitted with the program cards to enable the computer to produce the rest of the output. The actual order and setup of the cards for the whole forecasting system will be discussed in "Operation Instructions".

Page Three of the example printout has a table of population figures by age group for one year before the current year to five years after, projected by the program. The calculations take into account persistence rates and effects of new housing. The next line of print on page three represents the effective birth-rate for the same seven year period, based on the total population for the year, by applying the effective birth-rate of the previous year. The section of the program in which these calculations are made begins "Project Population (all age groups) and Births". The last item on page three is the projected housing supply (total number of housing units) divided into single-family and multi-family units, for that same seven year span. The total housing supply is calculated by adding the projected new housing for the year in question to the total housing for the previous year (total housing for CY-2 was input by the user, as you may recall).

Page four of the example printout has already been discussed.

Page Five has a table by grade across the same eleven year span as shown on page four containing 1) the percent of the total community school enrollments which refer to non-tuition public school, 2) the succession rates (see glossary), 3) the transfer rates (see glossary) and the mean and standard deviation of the transfer rates for each grade.

Page Six, the last page of the example printout, has another table of the succession rates by grade, showing the year to year change on a diagonal.

VOCEDENR - Description of Output

The main output of COMENR is a table of enrollments (both for the whole community and for the public schools alone), by grade and by grade group. VOCEDENR provides for tables of just vocational education enrollment figures, also by grade and grade group, separated out by program of study. If the user has available current program enrollments separated into the different schools in the district, this program will produce tables by school, as in the example printout. VOCEDENR takes as input the total public school enrollments by grade from COMENR, from the current year to five years beyond. If the user prefers to supply "override" enrollment information instead of that forecasted by COMENR, this can be done, as will be explained in the "Operations Instructions". The formula used for calculation of the vocational education enrollments is as follows:

Forecasted Enrollment for a Particular Year, Grade and Program =

$$\text{Current Enrollment for that Grade \& Program} \times \frac{\text{Total Public School Enrollment for the Year of Forecast \& that Grade}}{\text{The Current Total Public School Enrollment for that Grade}}$$

The output, as can be seen in the example printout, simply gives for each school and then for the whole district ("Total for all Schools") a table for each grade, by program of study, of the vocational education enrollments, across the six years just mentioned, current year to five years beyond. If the user has not provided current vocational education data for a particular grade (either because there are no vocational courses given in that grade, or because the information was not available), or for a particular program within a grade, there will be no table printed (or line of print within the table) for that item. The last table in the output is a total for all schools in the district and all grades in the schools.

SECTION IV

DETAILS OF PROGRAMS

Input Preparation

Preparation of Data Inputs A-COMENR

This section deals with the data cards containing the user-supplied information which is printed out on pages one and two of the example printout. Exhibit VI-1 is a printout of the data cards used in the example case, exactly as they are punched. The chart which follows shows what each of the cards contains and in which columns the information should be punched. Numbers should be right-justified within the columns allotted to them. This means, for example, if you have the number 123 and it is to be punched in columns 11-20, the card should look like this:

							1	2	3
11	12	13	14	15	16	17	18	19	20

Preparation of Data Inputs B- VOCEDENR

If the total public school enrollment figures are taken from COMENR, as was done in the example case, then the first set of data to be provided by the user is the list of program identification numbers and names of the vocational programs of study in the school district. The number of cards is equivalent to the number of programs, and the cards are punched as follows:

Chart IV-3

COLUMNS	CONTENTS	FORTRAN FORMAT
1-5	Any 5 digit and/or letter identification code for program	(A5)
9-24	Program Name	(2A8)

Figure IV-1

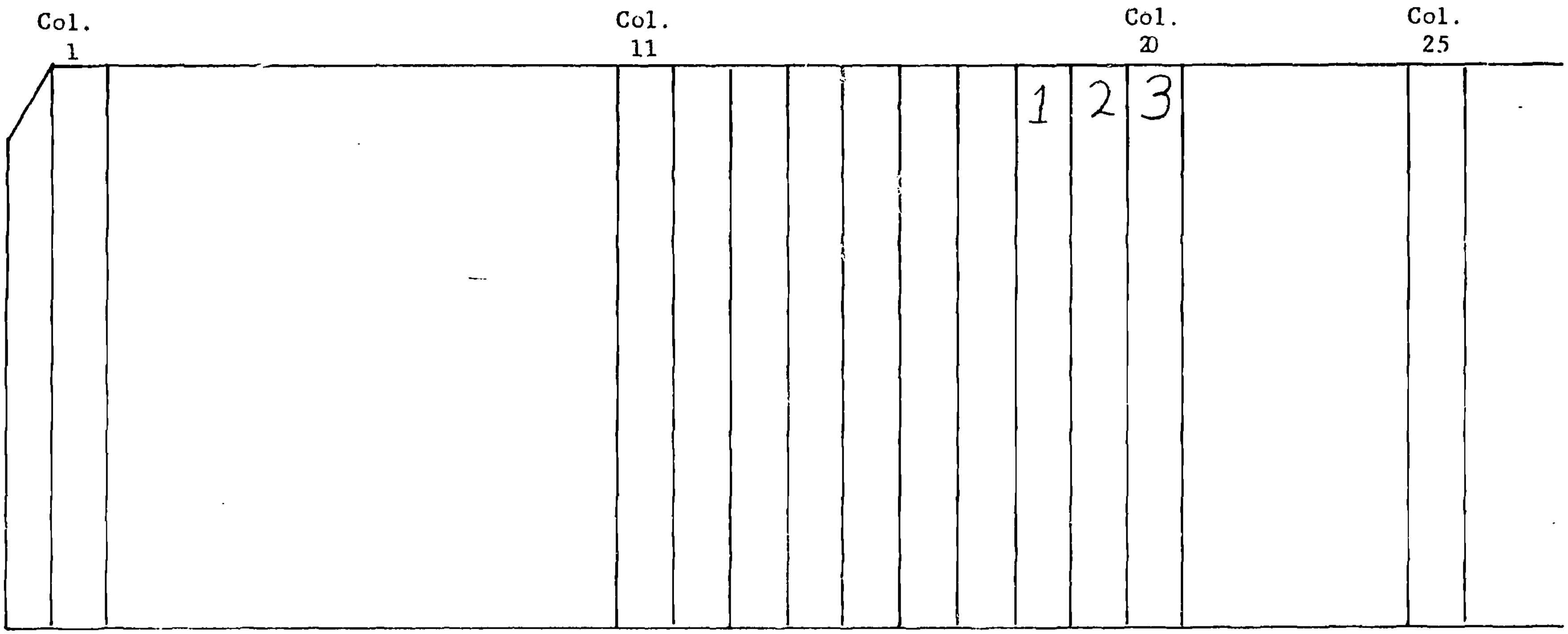


Figure IV-2

PREPARATION OF DATA INPUTS - A-COMENR

CARD TYPE	NO. CARDS	CONTENTS	COLUMNS	FORTRAN FORMAT
1	2	GRADE HEADINGS These cards can remain as in Exhibit VII-5. There should be no need to change them.	10 col/grade	(10A8)
2	1	RUN HEADING Any title which the user wishes will appear at the top of every page of output.	1-80	(10A8)
3	1	CURRENT FISCAL YEAR	2-5	(1x,I4)
4	1	PERSISTENCE RATES Punch all 6 age groups across one card.	8 col/age grp. including decimal point	(6F8.4)
5	2	PEOPLE-PER-ADDED-HOUSEHOLD Punch all 6 age groups across each card; one card for single-family, one card for multi-family.	5 col/age grp. including decimal point	(6F5.3)
6	14	ENROLLMENT OPERATORS Punch the three age groups across each card, one card per grade.	8 col/age grp. including decimal point	(3F8.4)
7	1	POPULATION For year CY-2; punch the 6 age groups across one card.	6 col/age grp.	(6I6)
8	4	COMMUNITY ENROLLMENTS Punch all 14 grades across each card - one card per year.	5 col/grade	(14I5)
9	4	PUBLIC ENROLLMENTS Punch all 14 grades across each card - one card per year.	5 col/grade	(14I5)

Figure IV-2 (cont'd)

PREPARATION OF DATA INPUTS - A-COMENR
(continued)

CARD TYPE	NO. CARDS	CONTENTS	COLUMNS	FORTRAN FORMAT
10	2	NEW HOUSING Punch all five years across each card - one card per year.	5 col/year	(5I5)
11	1	HOUSING SUPPLY CY-2 Punch 2 types of housing units across one card.	6 cols/hsg. type	(2I6)
12	1	HOUSING RULE AND EXPECTED NEW HOUSING FOR CY-2 (SINGLE-FAMILY)	5 cols/each	(2I5)
13	1	ACTUAL NEW HOUSING CY-2 Punch 2 types of housing units across one card.	5 cols/hsg. type	(2I5)
14	1	BIRTHS CY-2	1-5	(I5)
15	1	PUBLIC ENROLLMENT CY-1 Punch all 14 grades across one card.	5 cols/grade	(14I5)
16	1 (optional)	OVERRIDE	1-8	(A8)
17	2 (optional)	OVERRIDE INPUT FOR NEW HOUSING FIGURES CY-1-CY-5 Punch all 7 years across each card-one card/housing type.	5 cols/year	(7I5)

The next set of cards consists of the current enrollments in vocational educational programs, (by school),* by program by grade. The number of cards is optional. The program will process as much or as little information as it is given. One card represents (a single school), a single program and a single grade within that program. The grades are represented by their number values, except for elementary which is denoted 'E ', and Post Secondary which is denoted 'PS'. Seventh, eighth and ninth grades are punched with a zero before the number, as illustrated in the chart below:

Chart IV-4

COLUMNS	CONTENTS	FORTRAN FORMAT
1-2	Current Fiscal Year (last two digits)	(I2)
4-9	District (or School) Code - 6 digit number	(I6)
11-34	District and/or school name	(6A4,A1)
37-38	Grade (E_..07,08...PS)	(A2)
40-44	Program Code (5 numbers and/or letters)	(A5)
46-49	Enrollment (4 digit number)	(I4)

*school categorization is optional

Current year, district/school code, program code and enrollment must be "right-justified" (as explained earlier).

If VOCEDENR is to be run separately, with "override" total public school enrollment data provided by the user, the following 8 cards must precede the program list: one card per grade (first grade through sixth are summed to give a card for "elementary"), in order by grade, from elementary to post graduate, with total public school enrollments for six years, from current year to five years after-years going across the card.

Each card should thus have six numbers punched across, each number being given five columns, right-justified within those five columns. See the data printout section labelled "override total public enrollment figures."

SECTION V

OPERATION INSTRUCTIONS

The following charts represent card deck setups for running COMENR and VOCEDENR from source decks on an IBM 360 or 370 computer. If another machine is to be used job control language cards must be changed accordingly.

Chart V-1

RUN INSTRUCTIONS: COMENR VOCEDENR FROM SOURCE DECKS

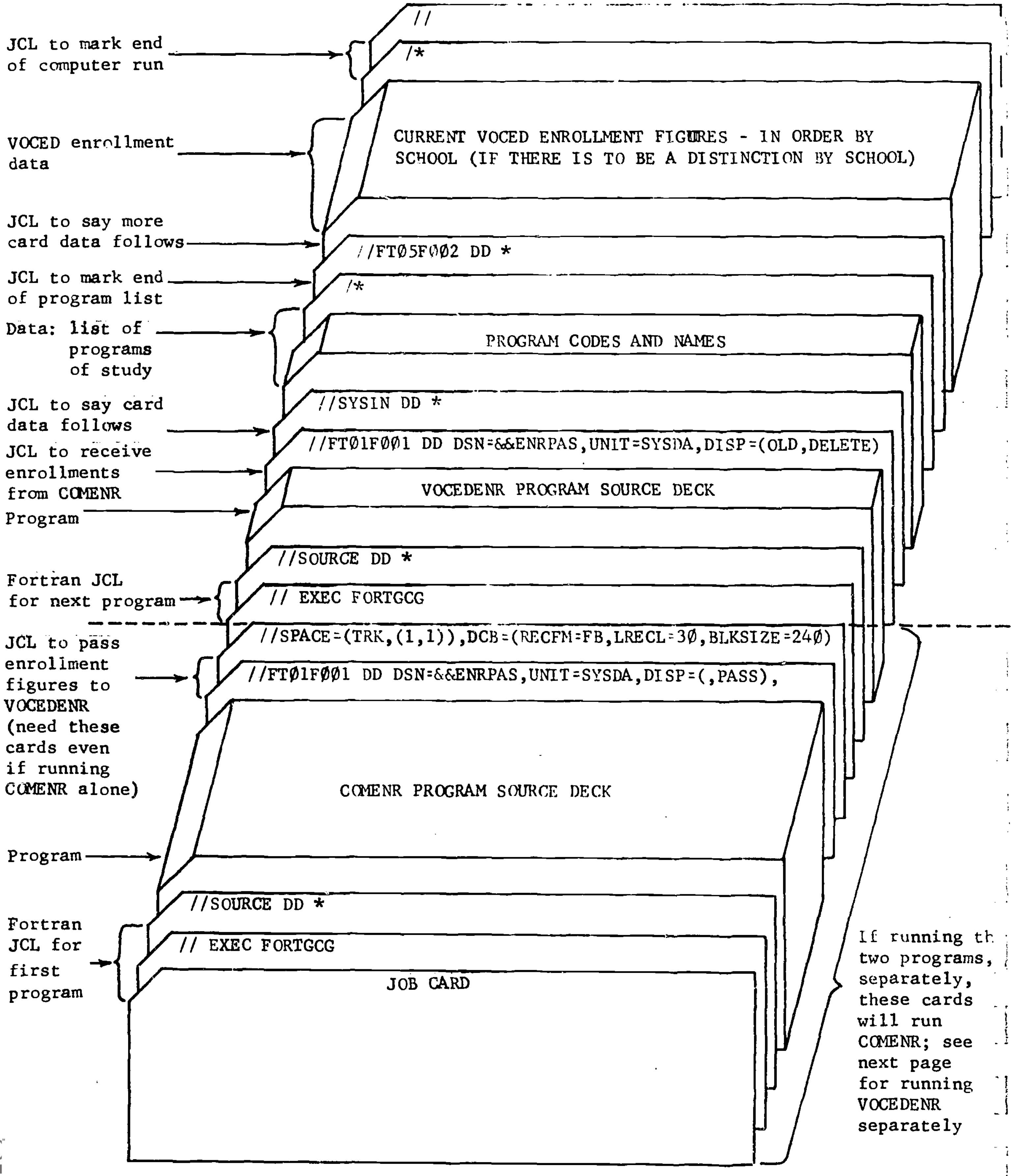
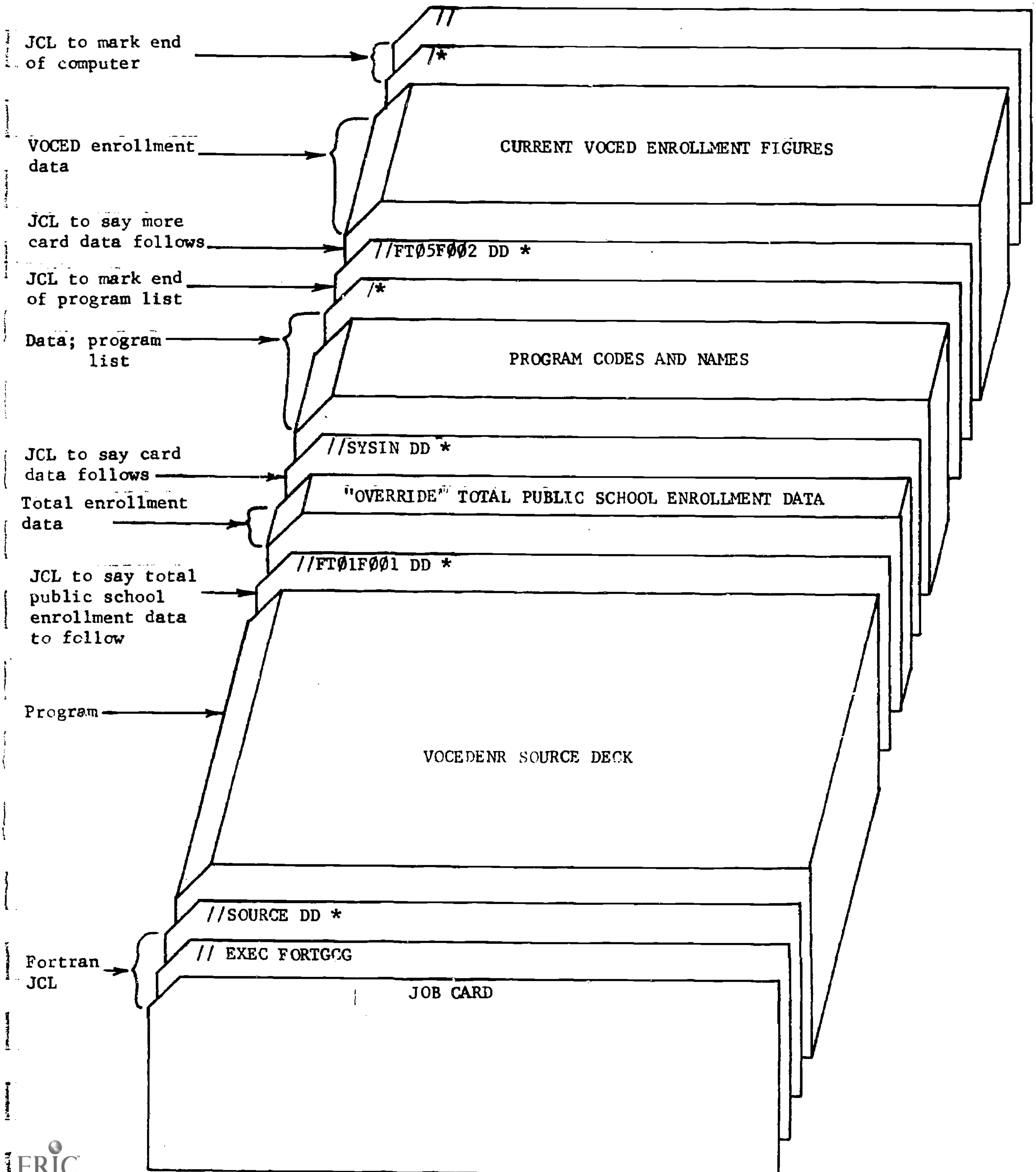


Chart V-2

RUN INSTRUCTIONS: VOCEDENR WITH OVERRIDE INFO PROVIDED BY USER FOR TOTAL PUBLIC SCHOOL ENROLLMENT



SECTION VI

TECHNICAL DETAILS & PREPARATION OF PARAMETERS

Procedures for Estimating Persistence and People-Per-New Housing Unit Factors

The persistence factors are deduced from data from the past two census (ten years apart) using linear regression.

(Users are assumed to have access to the necessary statistical competence.)

Let P_{2a} = population in age group a in the second of two census

Let P_{1a} = population in age group a in the earlier of two census

The age groups of interest are:

1: 0-4,

2: 5-9,

3: 10-14,

4: 15-19,

5: Total population,

6: 0-4 in relation to total population

A sample of about 20 counties with characteristics similar to the county in which the district exists (and including that county, if one wishes) should be chosen. From the census data for these counties, determine p_a^{10}, h_a, c_a by regression:

$$P_{2a} = P_a^{10} P_{1a} + h_a H + c_a \text{ for } a = 1\text{-}5$$

for a=6 use

$$P_{26} = P_6^{10} P_{25} + h_6 H + c_6$$

Here $\underline{H}$ is the number of new housing units built between the census years (including the former); data which is available from the census.

Assuming that the standard errors are low, the regression coefficient reasonably high, and the constant terms c_a are negligible, the relationships are a good fit. We can use them to extrapolate into the future.

The P_a (the 10th rooth of P_a^{10}) are the persistence factors. The h_a are the people in the corresponding age group per housing unit. The h_a can be used as input to the enrollment forecaster (unless better estimates for future values are available from some other source).

P_6 is called the "generation" rate.

<u>Enrollment-Operations</u>

The census data provides directly the data for translating population by age group to enrollment by grade group. (The latest census should be used.) The data by age group will not add up to 1.0 since not all children are in school (grades 1-12) especially age groups 5-9 and 14-19.

The inverse of this matrix will provide data for translating enrollment by grade to population by age group.

SECTION VII

PROGRAM LISTINGS

EXAMPLE OUTPUTS

```
      ENROLLMENT FORECASTER

   PROGRAMMING CONVENTIONS:

      --GENERAL FORMATS APPEAR AT TOP
            OF PROGRAM.

      --SPECIAL FORMATS APPEAR WHERE
            THEY ARE USED.

   INTEGER ARRAYS:

      --[illegible]   (YEAREX,AGEGRP)       POPULATION
      --YR            (YEAREX)              YEAR NUMBERS
      --[illegible]   (YEAREX,HSGTYP)       NEW HOUSING FIGURES
      --[illegible]   (YEAREX,HSGTYP)       HOUSING SUPPLY
      --[illegible]   (YEAREX,GRADEX)       COMMUNITY ENROLLMENT
      --[illegible]   (YEAREX,GRADEX)       PUBLIC ENROLLMENT
      --[illegible]   (YEAREX)              SUM OF PUBENR FOR GRADES 1-6
      --PVTENR        (YEAREX,GRADEX)       PRIVATE ENROLLMENT
      --RANKET        (1 TO 5)              WORK SPACE FOR SORTING
      --[illegible]   (YEAREX)              WORK SPACE

   REAL ARRAYS:

      --[illegible]   (AGEDEX,GRADEX)       ENROLLMENT OPERATORS         *
      --PRATNS        (AGEGRP,HSGTYP)       PEOPLE PER AGE PER HOUSEHOLD
      --[illegible]   (AGEGRP)              PERSISTENCE RATES
      --[illegible]   (AGEGRP)              TEMPORARY POPULATION FIGURES  **
      --[illegible]   (YEAREX,GRADEX)       % PUBLIC VS COMMUNITY ENROLLMENT
      --SUCRAT        (YEAREX,GRADEX)       SUCCESSION RATES
      --TRNFRS        (YEAREX,GRADEX)       TRANSFERS
      --TS            (GRADEX)              WEIGHTED SUM OF TRANSFERS-->AVG.
      --TSS           (GRADEX)              WEIGHTED SUM OF TRNFRS**2-->S.D.
      --[illegible]   (YEAREX)              WORK SPACE

                                          * NOTE SPECIAL AGE-GROUP-INDEX
                                         ** NOTE AGEGRP OFFSET

   [illegible] ARRAYS

      --GRDHDG        (GRADEX)              GRADE AND GRADE-CLUSTER HEADINGS
      --RUNHDG        (1 TO 10)             RUN HEADING

                                                   MAX.VALUE
                     AGEDEX:  AGE-GROUP-INDEX       ( 3)
                     AGEGRP:  AGE-GROUP             ( 6)
                     GRADEX:  GRADE-INDEX           (20)
                     HSGTYP:  HOUSING-TYPE          ( 2)
                     YEAREX:  YEAR-INDEX            (21)
```

Chart VII-1
Program Listing - COMENR

```
      C
      C
      C
      C       WHERE:
      C
      C          YEAR-INDEX : YEAR                 HOUSING-TYPE
      C              1         CURRENT-10
      C              2         CURRENT-9               1  SINGLE FAMILY
      C              9         CURRENT-2               2  MULTI-FAMILY
      C             10         CURRENT-1
      C             11         CURRENT YEAR
      C             12         CURRENT+1
      C             13         CURRENT+2
      C             20         CURRENT+9
      C             21         CURRENT+10
      C
      C
      C
      C
      C          GRADE-INDEX : GRADE        GRADE-INDEX : GRADE
      C                1         K               14       P. G.
      C                2         1               15       7 - 8
      C                3         2               16       9 - 12
      C                .         .               17       7 - 12
      C               12        11               18       7 - 9
      C               13        12               19      10 - 12
      C
      C
      C
      C         AGE-GROUP : AGES            ENROPR AGE-GROUP-INDEX : AGES
      C             1        BIRTHS
      C             2        0 - 4                  1              5 - 9
      C             3        5 - 9                  2             10 - 14
      C             4       10 - 14                 3             15 - 19
      C             5       15 - 19
      C             6        TOTAL
      C                                     PTEMP  AGE-GROUP-INDEX : AGES
      C
      C                                             1              < 1
      C                                             2             1 - 5
      C                                             3             6 - 10
      C                                             4            11 - 15
      C                                             5            16 - 20
      C                                             6             TOTAL
      C
      C
      C
      C
      C
      C
      C       DECLARATIONS:
      C
0001          INTEGER   ELENR(11)/11*0/
0002          INTEGER   POP(21,6),BIRTHS     ,KYR(21),NEWHSG(21,2),HSGSUP(21,2)
0003          INTEGER   COMENR(21,20)/420*0/,PURENR(21,20)/420*0/,PVTENR(21,20)
0004          INTEGER   RANKER(6),WORKER(21)
0005          INTEGER   AGEGRP,HSGTYP,AGEDEX,GRADEX,YEAREX,SAVER,EXPECT
0006          REAL      ENROPR(3,20),PPADHS(6,2),PRSTST(5),PTEMP(6)
0007          REAL      PCTPUB(21,20)/420*0.0/,  SUCNRT(21,20)/420*100.0/
0008          REAL      TRNFRS(21,20)/420*99999.0/
0009          REAL      TS(20)/20*0.0/,TSS(20)/20*0.0/,XWORK(21)
```

```
0010          REAL*8   GRDHDG(20),RUNHDG(10)
0011          REAL*8   OVRIDE,BLANKS/'        '/
        C
        C
        C     GENERAL FORMATS:
        C
0012        1 FORMAT('1',10A8,5X,'CURRENT-YEAR=',I5,10X,'PAGE ',I2)
0013        2 FORMAT (' ')
0014       20 FORMAT (' ',5X,A8,5X,11I7)
0015       21 FORMAT (/' ',18X,11I7)
0016       22 FORMAT (' ',5X,A8,5X,14F7.2)
        C
        C
        C     INITIALIZATION
        C
        C
        C     SET PAGE NUMBER TO 1
        C
0017          IPG=1
        C
        C     READ GRADE-HEADINGS ON TWO CARDS  AND  RUN-HEADING ON ONE CARD
        C
0018          READ(5,80) GRDHDG
0019          READ(5,80) RUNHDG
0020       80 FORMAT  (10A8)
        C
        C
        C     READ YEAR-NUMBER OF CURRENT YEAR  THEN FILL KYR ARRAY
        C
0021          READ(5,81) KYR(11)
0022       81 FORMAT(14,14)
0023          DO 60      YEAREX=1,21
0024          KYR(YEAREX)=KYR(11)-11+YEAREX
0025       60 CONTINUE
        C
        C
        C     SKIP TO A NEW PAGE IN PRINTER
        C
0026          WRITE(6,1)  RUNHDG, KYR(11),IPG
0027          IPG=IPG+1
        C
        C
        C     READ AND PRINT INPUT DATA.
        C
        C
        C              PERSISTENCE RATES
        C
0028          READ(5,91) (PRSIST(AGEGRP), AGEGRP=1,6)
0029       91 FORMAT(6F8.4)
0030          WRITE(6,110)(PRSIST(AGEGRP),AGEGRP=1,6)
0031      110 FORMAT (//' ',10X,'PERSISTENCE RATES BY AGE GROUP  (1 THROUGH 6)'/
             1           ' ',6F8.4)
        C
        C
        C              PEOPLE-PER-ADDED-HOUSEHOLD
        C
0032          READ(5,101)((PPADHS(AGEGRP,HSGTYP), AGEGRP=1,6), HSGTYP=1,2)
0033      101 FORMAT(6F5.3)
0034          WRITE(6,120)((PPADHS(AGEGRP,HSGTYP), AGEGRP=1,6), HSGTYP=1,2)
0035      120 FORMAT (//' ',10X,'PEOPLE-PER-ADDED-HOUSEHOLD BY AGE GROUP (1-6)'/
             1           ' ',6F8.4,' SINGLE-FAMILY'/' ',6F8.4,' MULTI-FAMILY')
```

```
            C
            C
            C              ENROLLMENT OPERATORS
            C
0036              READ(5,121)((ENROPR(AGEDEX,GRADEX),AGEDEX=1,3),GRADEX=1,14)
0037          121 FORMAT(3F8.4)
0038              WRITE(6,130)((ENROPR(AGEDEX,GRADEX),AGEDEX=1,3),GRADEX,
                 1GRADEX=1,14)
0039          130 FORMAT (//' ',10X,'ENROLLMENT OPERATORS BY AGE-GROUP-INDEX (1-3)',
                 1       14(/' ',3F8.4,' GRADEX ',I2))
            C
            C
            C              POPULATION
            C
0040              READ(5,131) (POP(9,AGEGRP), AGEGRP=1,6)
0041          131 FORMAT(6I6)
0042              WRITE(6,140)(POP(9,AGEGRP), AGEGRP=1,6)
0043          140 FORMAT (//' ',10X,'CY-2 POPULATION BY AGE GROUP (1-6)'/' ',6I6)
            C
            C
            C              COMMUNITY ENROLLMENT
            C
0044              READ(5,141)((COMENR(YEAREX,GRADEX), GRADEX=1,15),KY, YEAREX=6,9)
0045          141 FORMAT(15I5,1X,I3)
0046              WRITE(6,150)((COMENR(YEAREX,GRADEX), GRADEX=1,15),KYR(YEAREX),
                 1                YEAREX=6,9)
0047          150 FORMAT (//' ',10X,'COMMUNITY ENROLLMENTS BY GRADE-INDEX (1-15)',
                 1        4(/' ',15I5,I5))
            C
            C
            C              PUBLIC ENROLLMENT
            C
0048              READ(5,141)((PUBENR(YEAREX,GRADEX), GRADEX=1,15),KY, YEAREX=6,9)
0049              WRITE(6,160)((PUBENR(YEAREX,GRADEX), GRADEX=1,15),KYR(YEAREX),
                 1                YEAREX=6,9)
0050          160 FORMAT (//' ',10X,'PUBLIC ENROLLMENTS BY GRADE-INDEX (1-15)',
                 1        4(/' ',15I5,I5))
            C
            C
            C              NEW-HOUSING FIGURES
            C
0051              READ(5,151)((NEWHSG(YEAREX,HSGTYP), YEAREX=4,8), HSGTYP=1,2)
0052          151 FORMAT(5I5)
0053              WRITE(6,170)((NEWHSG(YEAREX,HSGTYP), YEAREX=4,8), HSGTYP=1,2)
0054          170 FORMAT (//' ',10X,'NEW-HOUSING FIGURES BY YEAR  (CY-7 THRU CY-3)'/
                 1        ' ',5I5,' SINGLE-FAMILY'/' ',5I5,' MULTI-FAMILY')
            C
            C
            C              HOUSING SUPPLY
            C
0055              WRITE(6,1)HOUSNG,KYR(11),IPG
0056              IPG=IPG+1
0057              READ(5,161) (HSGSUP(9,HSGTYP), HSGTYP=1,2)
0058          161 FORMAT(2I6)
0059              WRITE(6,180)(HSGSUP(9,HSGTYP), HSGTYP=1,2)
0060          180 FORMAT (//' ',10X,'HOUSING SUPPLY CY-2:  SINGLE-FAMILY  MULTI-FAMI
                 1LY'/' ',27X,2I9)
            C
            C              HOUSING RULE   AND   EXPECTED NEW HOUSING FOR CY-2
            C                                  (SINGLE-FAMILY)
```

```
      READ(5,171) NRULE,EXPECT
  171 FORMAT(2I5)
      WRITE(6,190) NRULE,EXPECT
  190 FORMAT (//' ',10X,'HOUSING RULE IN CY-2:',I4/' ',10X,'EXPECTED NEW
     1 SINGLE-FAMILY HOUSING FOR CY-2:',I6)
C
C
C               ACTUAL NEW HOUSING   AND   BIRTHS   FOR  CY-2
C
      READ(5,181) (NEWHSG(9,HSGTYP), HSGTYP=1,2), BIRTHS
  181 FORMAT(2I5/I5)
      WRITE(6,200)(NEWHSG(9,HSGTYP), HSGTYP=1,2), BIRTHS
  200 FORMAT (//' ',10X,'ACTUAL NEW SINGLE-FAMILY HOUSING FOR CY-2:',I6/
     1       ' ',10X,'ACTUAL NEW  MULTI-FAMILY HOUSING FOR CY-2:',I6/
     2         '0',10X,'BIRTHS FOR CY-2:',I6)
C
C
C               PUBLIC ENROLLMENT   FOR  CY-1
C
      READ(5,191) (PUBENR(10,GRADEX), GRADEX=1,15)
  191 FORMAT(15I5)
      WRITE(6,210)(PUBENR(10,GRADEX), GRADEX=1,15)
  210 FORMAT (//' ',10X,'PUBLIC ENROLLMENT BY GRADE-INDEX FOR CY-1'/
     1       ' ',15I5)
C
C
C               OVERRIDE INPUT FOR NEW-HOUSING FIGURES
C                           IN YEARS CY-1 THRU CY+5
C
      READ(5,220)OVRIDE
  220 FORMAT (A8)
      IF (OVRIDE.EQ.BLANKS)  GO TO 1000
      READ(5,201)((NEWHSG(YEAREX,HSGTYP), YEAREX=10,16), HSGTYP=1,2)
  201 FORMAT(7I5)
      WRITE(6,230)((NEWHSG(YEAREX,HSGTYP), YEAREX=10,16), HSGTYP=1,2)
  230 FORMAT(//' ',10X,'OVERRIDE INPUT FOR NEW-HOUSING FIGURES BY YEAR'/
     1        ' ',15X,'IN YEARS CY-1 THROUGH CY+5'/
     2        ' ',7I5,' SINGLE-FAMILY'/' ',7I5,' MULTI-FAMILY')
C
C                    SKIP PROJECTION OF NEW-HOUSING FIGURES,
C                     SINCE OVERRIDE INPUT WAS ENTERED.
C
      GO TO 1500
C
C
C     CALCULATE  HOUSING  GROWTH
C
C          (I.E., PROJECT NEW-HOUSING FIGURES)
C
C
C
C               DETERMINE NEW HOUSING-GROWTH RULE
C
 1000 WRITE(6,1010)NRULE
 1010 FORMAT (//' ',10X,'OLD HOUSING-GROWTH RULE:',I2)
      XPECT=EXPECT
      HRATIO=NEWHSG(7,1)/XPECT
      IF (HRATIO.GE.1.2)  NRULE=2
      IF (HRATIO.LE.0.8)  NRULE=1
      WRITE(6,1020)NRULE
```

```
0088      1020 FORMAT (' ',10X,'NEW HOUSING-GROWTH RULE:',I2)
          C
          C
          C              PROJECT  SINGLE-FAMILY  NEW-HOUSING  FIGURES
          C
          C  MOVE RELEVANT VALUES (YEARS CY-7 THRU CY-2) FROM NEWHSG ARRAY
          C    TO CORRESPONDING POSITIONS IN RANKER ARRAY.
          C
0089           DO 1040   J=4,9
0090           RANKER(J-3)=NEWHSG(J,1)
0091      1040 CONTINUE
          C
          C
          C  SORT RELEVANT VALUES IN RANKER ARRAY
          C    INTO ASCENDING ORDER.
          C
0092      1050 ITEST=0
0093           DO 1060   J=1,5
0094           IF (RANKER(J).LE.RANKER(J+1))   GO TO 1060
0095           SAVER=RANKER(J)
0096           RANKER(J)=RANKER(J+1)
0097           RANKER(J+1)=SAVER
0098           ITEST=1
0099      1060 CONTINUE
0100           IF (ITEST.EQ.1)   GO TO 1050
          C
          C
          C  SUM OF 3 HIGHEST VALUES --> TOPK
          C  SUM OF 3 LOWEST  VALUES --> BOTK
          C
0101           TOPK=RANKER(4)+RANKER(5)+RANKER(6)
0102           BOTK=RANKER(1)+RANKER(2)+RANKER(3)
          C
          C
          C  COMPUTE AVERAGES OF TOP 3, BOTTOM 3,
          C    AND ALL 6 VALUES.
          C
0103           TOPAVG=TOPK/3.
0104           BOTAVG=BOTK/3.
0105           ALLAVG=(TOPK+BOTK)/6.
          C
          C
          C  IF NRULE IS 1 ....
          C
0106           IF (NRULE.NE.1)   GO TO 1100
0107           DO 1070   J=10,16
0108           NEWHSG(J,1)=BOTAVG+0.5
0109      1070 CONTINUE
          C
          C
          C  IF NRULE IS 2 ....
          C
0110      1100 IF (NRULE.NE.2)   GO TO 1150
0111           INCRMT=(TOPAVG-ALLAVG)/3. +0.5
0112           DO 1110   J=10,16
0113           NEWHSG(J,1)=NEWHSG(J-1,1)+INCRMT
0114      1110 CONTINUE
          C
          C
          C              PROJECT  MULTI-FAMILY  NEW-HOUSING  FIGURES
          C
```

```
              C   FIND LARGEST AND SMALLEST VALUES
              C    FOR YEARS CY-7 THROUGH CY-2
              C
   0115         1150 ITOP=NEWHSG(4,2)
   0116              IBOT=NEWHSG(4,2)
   0117              DO 1160   J=5,9
   0118              ITOP= MAXO(ITOP,NEWHSG(J,2))
   0119              IBOT= MINO(IBOT,NEWHSG(J,2))
   0120         1160 CONTINUE
              C
              C
              C   PROJECT USING FORMULA
              C
   0121              VALUE=0.6*ITOP + 0.4*IBOT + 0.5
   0122              DO 1170   J=10,16
   0123              NEWHSG(J,2)=VALUE
   0124         1170 CONTINUE
              C
              C
              C
              C      PROJECT  HOUSING  SUPPLY
              C
              C
   0125         1500 DO 1520   YEAREX=10,16
   0126              DO 1510   HSGTYP=1,2
   0127              HSGSUP(YEAREX,HSGTYP)=HSGSUP(YEAREX-1,HSGTYP)+
                    1                       NEWHSG(YEAREX-1,HSGTYP)
   0128         1510 CONTINUE
   0129         1520 CONTINUE
              C
              C
              C      PRINT NEW-HOUSING FIGURES FOR YEARS  CY-7  THROUGH  CY+5
              C
   0130              WRITE(6,1530)((NEWHSG(YEAREX,HSGTYP), YEAREX=4,16), HSGTYP=1,2)
   0131         1530 FORMAT (//' ',10X,'NEW-HOUSING FIGURES BY YEAR:  CY-7 THRU CY+5'/
                    1           ' ',13I5,' SINGLE-FAMILY'/
                    2           ' ',13I5,' MULTI-FAMILY')
              C
              C
              C
              C      PROJECT POPULATION (ALL 6 AGE GROUPS)   AND BIRTHS
              C
              C           FOR YEARS  CY-1  THROUGH  CY+5
              C
              C
              C   FOR EACH YEAR, CALCULATE, AND STORE IN PTEMP ARRAY,
              C    THE POPULATION IN EACH AGE-GROUP FROM THE PRECEDING YEAR
              C    MODIFIED BY PERSISTENCE RATES AND EFFECTS OF NEW-HOUSING.
              C    NOTE THAT THE PRECEDING YEAR'S BIRTHS ARE USED IN LIEU OF POP.< 1.
   0132              DO 1560   YEAREX=10,16
   0133              PTEMP(1)=BIRTHS*PRSIST(1)+
                    1             NEWHSG(YEAREX-1,1)*PPADHS(1,1)+
                    2             NEWHSG(YEAREX-1,2)*PPADHS(1,2)
   0134              DO 1550   AGEGRP=2,6
   0135              PTEMP(AGEGRP)=POP(YEAREX-1,AGEGRP)*PRSIST(AGEGRP)+
                    1                  NEWHSG(YEAREX-1,1)*PPADHS(AGEGRP,1)+
                    2                  NEWHSG(YEAREX-1,2)*PPADHS(AGEGRP,2)
   0136         1550 CONTINUE
              C
              C
              C   NOW CALCULATE THE POPULATION IN EACH AGE-GROUP FOR THE YEAR
```

```
              C     BY THE FOLLOWING FORMULAS BASED ON THE PTEMP ARRAY.
              C
0137                POP(YEAREX,1)=PTEMP(1)  +0.5
0138                POP(YEAREX,2)=PTEMP(1) + 0.8*PTEMP(2)      +0.5
0139                POP(YEAREX,3)= 0.2*PTEMP(2) + 0.8*PTEMP(3)+0.5
0140                POP(YEAREX,4)= 0.2*PTEMP(3) + 0.8*PTEMP(4)+0.5
0141                POP(YEAREX,5)= 0.2*PTEMP(4) + 0.8*PTEMP(5)+0.5
0142                POP(YEAREX,6)=PTEMP(6)  +0.5
              C
              C
              C   CALCULATE THE BIRTHS FOR THE YEAR,BASED ON THE TOTAL POPULATION FOR
              C    THE YEAR, BY APPLYING THE EFFECTIVE BIRTH-RATE OF THE PRECEDING YEAR.
              C
0143                XPOP1=POP(YEAREX-1,1)
0144                BRTHRT=XPOP1/POP(YEAREX-1,6)
0145                BIRTHS=BRTHRT*PTEMP(6) +0.5
0146           1560 CONTINUE
              C
              C
              C
              C              PROJECT COMMUNITY ENROLLMENT    FROM POP AND ENROPR ARRAYS.
              C               (FOR YEARS  CY-1 THROUGH CY+5)
              C
0147           1600 DO 1620   YEAREX=10,16
0148                DO 1610   GRADEX=1,14
0149                COMENR(YEAREX,GRADEX)=POP(YEAREX,3)*ENROPR(1,GRADEX)+
                   1                          POP(YEAREX,4)*ENROPR(2,GRADEX)+
                   2                          POP(YEAREX,5)*ENROPR(3,GRADEX)+ 0.5
0150           1610 CONTINUE
0151           1620 CONTINUE
              C
              C
              C
              C              PRINT  (ACROSS YEARS):
              C
              C                   --POPULATION  BY  AGE-GROUP
              C
              C                   --EFFECTIVE  BIRTH-RATE
              C
              C                   --HOUSING  SUPPLY  BY  HOUSING-TYPE
              C
              C                   --TOTAL  HOUSING  SUPPLY
              C
              C    PRINT HEADING
              C
0152           1650 WRITE(6,1) RUNHDG,KYR(11),IPG
0153                IPG=IPG+1
0154                WRITE(6,1660)(KYR(YEAREX),YEAREX=10,16)
0155           1660 FORMAT (/' ',' AGE',4X,7I6)
              C
              C
              C    PRINT POPULATION BY AGE-GROUP
              C
0155                WRITE(6,1670)((POP(YEAREX,AGEGRP), YEAREX=10,16), AGEGRP=1,6)
0157           1670 FORMAT (/' ','   < 1',3X,7I6/' ',' 0 - 4',3X,7I6/
                   1        ' ',' 5 - 9',3X,7I6/' ','10 - 14',2X,7I6/
                   2        ' ','15 - 19',2X,7I6/' ',' TOTAL',3X,7I6)
              C
              C
              C    CALCULATE EFFECTIVE BIRTH-RATE
              C
```

```
0158              DO 1680   YEAREX=10,16
0159              WORKER(YEAREX)= 1000.*POP(YEAREX,1)/POP(YEAREX,6)   +0.5
0160         1680 CONTINUE
              C
              C
              C  PRINT EFFECTIVE BIRTH-RATE
              C
0161              WRITE(6,1690)(WORKER(YEAREX), YEAREX=10,16)
0162         1690 FORMAT (/' ','F.B.RATE ',7I6)
              C
              C
              C  PRINT HOUSING SUPPLY BY HOUSING-TYPE
              C
0163              WRITE(6,1700)((HSGSUP(YEAREX,HSGTYP), YEAREX=10,16), HSGTYP=1,2)
0164         1700 FORMAT (//' ','HOUSING SUPPLY'/
                 1             ' ','SING.FAM ',7I6/
                 2             ' ','MULT.FAM ',7I6)
              C
              C
              C  CALCULATE TOTAL HOUSING SUPPLY
              C
0165              DO 1710   YEAREX=10,16
0166              WORKER(YEAREX)=HSGSUP(YEAREX,1)+HSGSUP(YEAREX,2)
0167         1710 CONTINUE
              C
              C
              C  PRINT TOTAL HOUSING SUPPLY
              C
0168              WRITE(6,1720)(WORKER(YEAREX), YEAREX=10,16)
0169         1720 FORMAT (' ',' TOTAL',3X,7I6)
              C
              C
              C
              C         PRODUCE AND PRINT  (ACROSS YEARS  CY-5 THROUGH CY+5):
              C
              C            --NEW HOUSING BY HOUSING-TYPE
              C
              C            --COMMUNITY ENROLLMENT BY GRADE (AND GRADE-CLUSTER)
              C
              C            --PUBLIC ENROLLMENT BY GRADE (AND GRADE-CLUSTER)
              C            --SUCCESSION RATE BY GRADE
              C            --TRANSFERS  BY  GRADE
              C
              C  PRINT HEADING:
              C
0170         1800 WRITE(6,1) RUNHDG,KYR(11),IPG
0171              IPG=IPG+1
0172              WRITE(6,21) (KYR(YEAREX),YEAREX=6,16)
              C
              C
              C  PRINT NEW HOUSING BY HOUSING-TYPE
              C
0173              WRITE(6,1820)((NEWHSG(YEAREX,HSGTYP), YEAREX=6,16), HSGTYP=1,2)
0174         1820 FORMAT  (/' ','ANNUAL HOUSING GAIN'/
                 1          ' ','SING.FAM',10X,11I7/' ','MULT.FAM',10X,11I7)
              C
              C
              C  CALCULATE COMMUNITY ENROLLMENT BY GRADE-CLUSTER
              C
0175              DO 1840   YEAREX=6,16
0176              DO 1830   GRADEX=8,13
```

```
0177           L=CCMENR(YEAREX,GRADEX)
0173           IF (GRADEX.GE. 8 .AND. GRADEX.LE. 9)
              1          CCMENR(YEAREX,15)=COMENR(YEAREX,15)+L
0179           IF (GRADEX.GE. 10 .AND. GRADEX.LE. 13)
              1          CCMENR(YEAREX,16)=COMENR(YEAREX,16)+L
0180           IF (GRADEX.GE. 8 .AND. GRADEX.LE. 13)
              1          CCMENR(YEAREX,17)=COMENR(YEAREX,17)+L
0181           IF (GRADEX.GE. 8 .AND. GRADEX.LE. 10)
              1          CCMENR(YEAREX,18)=COMENR(YEAREX,18)+L
0132           IF (GRADEX.GE. 11 .AND. GRADEX.LE. 13)
              1          CCMENR(YEAREX,19)=COMENR(YEAREX,19)+L
0183      1839 CONTINUE
0184      1840 CONTINUE
          C
          C
          C  PRINT COMMUNITY ENROLLMENT BY GRADE AND GRADE-CLUSTER
          C
0185           WRITE(6,1850)
0186      1850 FORMAT  (/' ','COMMUNITY TOTAL ENROLLMENTS BY GRADE')
0187           DO 1860   GRADEX=1,19
0188           IF (GRADEX.EQ.15 .OR. GRADEX.EQ.19)  PRINT 2
0189           WRITE(6,20)     GROHDG(GRADEX),(COMENR(YEAREX,GRADEX),YEAREX=6,16)
0190      1860 CONTINUE
          C
          C
          C
          C  CALCULATE PERCENT-PUBLIC, SUCCESSION RATES, AND TRANSFERS
          C      (AND WEIGHTED SUM OF TRANSFERS AND TRANSFERS**2)
          C
          C      FOR YEARS  CY-5 THROUGH CY-1
          C      AND GRADE-INDEX  1 THROUGH 14     FOR  PERCENT-PUBLIC
          C
          C      FOR YEARS  CY-4 THROUGH CY-1
          C      AND GRADE-INDEX  2 THROUGH 14     FOR THE OTHERS
          C
0191           DO 1881 YEAREX=6,10
0192           TRNFRS(YEAREX+1,1)=PUBENR(YEAREX+1,1)-((COMENR(YEAREX+1,1)
              1 /CCMENR(YEAREX,1))*PUBENR(YEAREX,1))
0193      1881 CONTINUE
0194           DO 1882 YEAREX=7,10
0195           WEIGHT=YEAREX-6
0196           TS(1)=TS(1)+TRNFRS(YEAREX,1)*WEIGHT
0197           TSS(1)=TSS(1)+TRNFRS(YEAREX,1)**2*WEIGHT
0198      1882 CONTINUE
0199           DO 1880    YEAREX=6,10
0200           DO 1870    GRADEX=1,14
0201           D=CCMENR(YEAREX,GRADEX)
0202           IF (D.GT.0.)  PCTPUR(YEAREX,GRADEX)=PUBENR(YEAREX,GRADEX)*100./D
0203           IF (YEAREX.EQ.6 .OR. GRADEX.EQ.1)  GO TO 1870
0204           D=CCMENR(YEAREX-1,GRADEX-1)
0205           IF (D.GT.0.)  SUCRT(YEAREX,GRADEX)=COMENR(YEAREX,GRADEX)*100./D
0206           T=PUBENR(YEAREX,GRADEX)-0.01*SUCRT(YEAREX,GRADEX)*
              1                               PUBENR(YEAREX-1,GRADEX-1)
0207           TRNFRS(YEAREX,GRADEX)=T
0208           WEIGHT=YEAREX-6
0209           TS(GRADEX)= TS(GRADEX)+ T*WEIGHT
0210           TSS(GRADEX)=TSS(GRADEX)+T*T*WEIGHT
0211      1870 CONTINUE
0212      1880 CONTINUE
          C
          C
```

```
      C   CALCULATE WEIGHTED AVERAGE AND STANDARD DEVIATION
      C      FOR  TENERS  (IN YEARS  CY-4 THROUGH CY-1)
      C
0213        DO 1890   GRADEX=1,14
0214        AV = TS(GRADEX)/10.
0215        VAR = (TSS(GRADEX)- AV*TS(GRADEX))/9.0
0216        IF (VAR.LT.0.)  VAR=0.
0217        TS(GRADEX) =AV
0218        TSS(GRADEX)=SQRT(VAR)
0219   1890 CONTINUE
      C
      C
      C
      C   CALCULATE SUCCESSION RATES, PUBLIC ENROLLMENT, AND PERCENT PUBLIC
      C
      C      FOR YEARS  CY THROUGH CY+5
      C
      C      FOR GRADE-INDEX  2 THRU 13
      C
0220        DO 1909 YEAREX=11,16
0221        PUBENR(YEAREX,1)=(COMENR(YEAREX,1)/COMENR(YEAREX-1,1))
           1 *PCOMEN(YEAREX-1,1)+TS(1)+.5
0222   1909 CONTINUE
0223        DO 1910   YEAREX=11,16
0224        DO 1900   GRADEX=2,13
0225        D=COMENR(YEAREX-1,GRADEX-1)
0226        IF (D.GT.0.)  SUCRAT(YEAREX,GRADEX)=COMENR(YEAREX,GRADEX)*100./D
0227        PUBENR(YEAREX,GRADEX)=0.01*SUCRAT(YEAREX,GRADEX)*
           1                        PUBENR(YEAREX-1,GRADEX-1) + TS(GRADEX)+.5
0228        D=COMENR(YEAREX,GRADEX)
0229        IF (D.GT.0.)  PCTPUB(YEAREX,GRADEX)=PUBENR(YEAREX,GRADEX)*100./D
0230   1900 CONTINUE
      C
      C      NOW FOR GRADE-INDEX  14
      C
0231        PCTPUB(YEAREX,14)= PCTPUB(10,14)
0232        PUBENR(YEAREX,14)=0.01*PCTPUB(YEAREX,14)*COMENR(YEAREX,14) +0.5
0233   1910 CONTINUE
      C
      C
      C   CALCULATE PUBLIC ENROLLMENT BY GRADE-CLUSTER
      C
0234        DO 1930   YEAREX=6,16
0235        DO 1920 GRADEX=2,13
0236        L=PUBENR(YEAREX,GRADEX)
0237        IF(GRADEX.GE.2.AND.GRADEX.LE.7) ELENR(YEAREX)=ELENR(YEAREX)+L
0238        IF (GRADEX.GE.  8 .AND. GRADEX.LE.  9)
           1          PUBENR(YEAREX,15)=PUBENR(YEAREX,15)+L
0239        IF (GRADEX.GE. 10 .AND. GRADEX.LE. 13)
           1          PUBENR(YEAREX,16)=PUBENR(YEAREX,16)+L
0240        IF (GRADEX.GE.  8 .AND. GRADEX.LE. 13)
           1          PUBENR(YEAREX,17)=PUBENR(YEAREX,17)+L
0241        IF (GRADEX.GE.  8 .AND. GRADEX.LE. 10)
           1          PUBENR(YEAREX,18)=PUBENR(YEAREX,18)+L
0242        IF (GRADEX.GE. 11 .AND. GRADEX.LE. 13)
           1          PUBENR(YEAREX,19)=PUBENR(YEAREX,19)+L
0243   1920 CONTINUE
0244   1930 CONTINUE
      C
      C
      C   PRINT PUBLIC ENROLLMENT BY GRADE AND GRADE-CLUSTER
```

```
      C
            WRITE(6,1940)
       1940 FORMAT  (/' ','PUBLIC ENROLLMENTS BY GRADE')
            DO 1950   GRADEX=1,19
            IF (GRADEX.EQ.15 .OR. GRADEX.EQ.19)  WRITE(6,2)
            WRITE(6,20)    GRDHDG(GRADEX),(PUBENR(YEAREX,GRADEX),YEAREX=6,16)
       1950 CONTINUE
            WRITE(1,1111)(ELENR(YEAREX),YEAREX=6,11)
       1111 FORMAT(6I5)
            DO 1951 GRADEX=8,14
            WRITE(1,1111)(PUBENR(YEAREX,GRADEX),YEAREX=11,16)
       1951 CONTINUE
      C
      C
      C  PRINT   PERCENT PUBLIC, SUCCESSION RATE, AND TRANSFERS
      C             (INCLUDING WEIGHTED AVG. AND S.D. OF TRANSFERS
      C                                              OVER YEARS  CY-4 THROUGH CY-1)
      C               ALL BY GRADE
      C
            WRITE(6,1) RUNHDG,KYR(11),IPG
            IPG=IPG+1
            WRITE(6,21) (KYR(YEAREX),YEAREX=6,16)
            WRITE(6,1960)
       1960 FORMAT  ('+',98X,'AVE    S.D.')
            WRITE(6,1970)
       1970 FORMAT  (/' ','NONTUITION PUBLIC ROLL AS % OF COMMUNITY ROLL'/
           1           ' ',' AND SUCCESSION RATES AND TRANSFERS...')
            DO 1980   GRADEX=1,14
            WRITE(6,2)
            WRITE(6,22)    GRDHDG(GRADEX),(PCTPUB(YEAREX,GRADEX),YEAREX=6,16)
            WRITE(6,22)    GRDHDG(GRADEX),(SUCRAT(YEAREX,GRADEX),YEAREX=6,16)
            WRITE(6,22)    GRDHDG(GRADEX),(TRNFRS(YEAREX,GRADEX),YEAREX=6,16),
           1               TS(GRADEX),TSS(GRADEX)
       1980 CONTINUE
      C
      C
      C  PRINT   SUCCESSION-RATE TABLE    BY GRADE
      C
            WRITE(6,1) RUNHDG,KYR(11),IPG
            IPG=IPG+1
            WRITE(6,1990)
       1990 FORMAT  (/' ','SUCCESSION RATES BY GRADE (READ DIAGONALLY)'/
           1           ' ','FROM')
            DO 2010   GRADEX=1,13
            LASTYR= GRADEX+6
            IF (LASTYR.GT.16)  LASTYR=16
            DO 2000   YEAREX=6,LASTYR
            XWORK (YEAREX)=1.E10
            IF (YEAREX.EQ.11)  XWORK (YEAREX)=100.0
            IF (YEAREX.LE.11)  GO TO 2000
            D=PUBENR(11,GRADEX-YEAREX+11)
            IF (D.GT. 0.0)       XWORK(YEAREX)=PUBENR(YEAREX,GRADEX)*100.0/D
       2000 CONTINUE
            WRITE(6,22)    GRDHDG(GRADEX),(XWORK(YEAREX), YEAREX=6,LASTYR)
       2010 CONTINUE
            WRITE(6,1) RUNHDG,KYR(11),IPG
            STOP
            END
```

```
C  ENROLLMENT FORECASTER: PREDICTS ENROLLMENTS BY SCHOOL BY GRADE OR
C   GRADE GROUP FOR EACH PROGRAM FOR CURRENT YEAR(CY) TO CURRENT YEAR + 5
C   (Y5) USING INPUT FROM COMENR FOR TOTAL ENROLLMENTS
C  INPUT:
C     TE(YEAR,GRADE) TOTAL ENROLLMENTS FROM COMENR
C     PRNY(PROGRAM,4) ARRAY OF PROGRAM NAMES:
C     DATA ON CURRENT ENROLLMENTS:
C      CY CURRENT YEAR
C       RSCHL SCHOOL ID FOR SCHOOL BEING READ IN
C       SCHNAM(7) SCHOOL NAME
C       GRADE  IN THE FORM E ,07,09....PS  READ IN ALPHA
C       PROG  PROGRAM(A-N) READ IN ALPHA
C       ENROL  CURRENT ENROLLMENT FOR THAT YEAR,SCHOOL, GRADE AND PROGRAM
C  FORMAT FOR INPUT CARDS: (I2,1X,I6,1X,6A4,A1,1X,A2,1X,A1,1X,I4)
C  PREVIOUS SCHOOL ID IS STORED IN SCHOOL, PREVIOUS SCHOOL NAME IN SAVNAM
C  TESTING ARRAYS:
C     GRY(8) THIS IS USED TO DETERMINE PROPER SUBSCRIPT FOR ALPHA GRADE
C     PRY(15) THIS IS USED TO DETERMINE PROPER SUBSCRIPT FOR ALPHA PROGRAM ID
C     FLAGS(13) LOGICAL*1 ELEMENTS ARE SET TO .TRUE. IF CORRESPONDING GRADE
C     OR GRADE GROUP EXISTS FOR PARTICULAR SCHOOL BEING PROCESSED; THIS IS
C     TO AVOID ALL-ZERO TABLES BEING PRINTED OUT
C     ENDJ LOGICAL*1 TEST FOR END OF DATA- PRINT OUT LAST TABLE AND CALCULATE
C     TOTALS
C  OUTPUT:
C     FE(YEAR,GRADE,PROGRAM) ENROLLMENT FORCASTED FOR A PARTICULAR SCHOOL BY
C     GRADE OR GRADE GROUP BY PROGRAM FOR CY TO Y5; ALGORITHM FOR CALCULATION:
C     MULTIPLY CURRENT ENROLLMENT BY RATIO OF TOTAL ENROLLMENT FOR YEAR IN
C     QUESTION/TOTAL ENROLLMENT FOR CY
C     TOTFE(YEAR,GRADE,PROG) TOTAL OF FE FOR ALL SCHOOLS
C     TGREF(YEAR,PROG) TOTAL OF TOTFE FOR ALL GRADES
C     TOTPR(YEAR) TOTAL OVER ALL PROGRAMS OF EACH YEAR, FOR A PARTICULAR
C     SCHOOL AND GRADE OR GRADE GROUP
      REAL*8 PRNY(30,3)
      REAL*8 PRAG
      INTEGER*4 TE(6,8),FE(6,13,30)/2340*0/,TOTFE(6,13,30)/2340*0/,
     1 TGREF(6,30)/180*0/,TOTPR(6)/6*0/,CY,GR,YR,PR,SCHOOL,RSCHL
      INTEGER*4 Y5,SCHNAM(7),ENROL,SAVNAM(7)
      INTEGER*2 GRADE,PROG
      INTEGER*2 GRY(8)/'E ','07','08','09','10','11','12','PS'/
      LOGICAL*1 FLAGS(13)/13*.FALSE./,ENDJ/.FALSE./
      K=0
C  READ IN TOTAL ENROLLMENTS FROM COMENR
      DO 10 I=1,8
      READ(1,1)(TE(YR,I),YR=1,6)
    1 FORMAT(16I5)
   10 CONTINUE
C  READ IN PROGRAM ID NOS. AND NAMES
      DO 15 I=1,30
      READ(5,151,END=166)(PRNY(I,J),J=1,3)
  151 FORMAT(A5,3X,2A8)
   15 CONTINUE
  166 NOPROG=I-1
C  READ AN INPUT CARD
   20 READ(5,2,END=2002) CY,RSCHL,SCHNAM,GRADE,PRAG,ENROL
    2 FORMAT(I2,1X,I6,1X,6A4,A1,1X,A2,1X,A5,1X,I4)
      K=K+1
C  IF FIRST TIME THROUGH, STORE SCHOOL AND SCHOOL NAME IN VARIABLES FOR
C  PREVIOUS SCHOOL AND NAME
      IF(K.EQ.1) GO TO 202
C  IF NEW SCHOOL, GO TO OUTPUT SECTION FOR PREVIOUS SCHOOL
      IF(RSCHL.NE.SCHOOL) GO TO 1000
```

Chart VII-2
Program Listing - VOCEDENR

```
C     CALCULATE SUBSCRIPT FOR GRADE; SET CORRESPONDING FLAGS
   24 DO 25 I=1,8
      IF(GRADE.EQ.GRY(I)) GO TO 30
   25 CONTINUE
   30 GRADE=I
      FLAGS(GRADE)=.TRUE.
      IF(GRADE.EQ.2.OR.GRADE.EQ.3) GO TO 41
      IF(GRADE.EQ.4) GO TO 43
      IF(GRADE.GE.5.AND.GRADE.LE.7) GO TO 44
      GO TO 32
   41 FLAGS(9)=.TRUE.
      FLAGS(10)=.TRUE.
      FLAGS(11)=.TRUE.
      GO TO 32
   43 FLAGS(10)=.TRUE.
      FLAGS(11)=.TRUE.
      FLAGS(12)=.TRUE.
      GO TO 32
   44 FLAGS(11)=.TRUE.
      FLAGS(12)=.TRUE.
      FLAGS(13)=.TRUE.
C     CALCULATE SUBSCRIPT FOR PROGRAM
   32 DO 35 I=1,NOPROG
      IF(PRAG.EQ.PRNY(I,1)) GO TO 40
   35 CONTINUE
      WRITE(6,177) PRAG
  177 FORMAT('1PROGRAM NUMBER ',A5,' NOT IN LIST FOR THIS DISTRICT. SKIP
     1 CARD AND READ NEXT')
      GO TO 20
   40 PROG=I
C     STORE ENROL IN EF FOR CURRENT YEAR
   50 EF(1,GRADE,PROG)=ENROL
      TOTEF(1,GRADE,PROG)=TOTEF(1,GRADE,PROG)+ENROL
C     CALCULATE EF FOR NEXT 5 YEARS
      DO 75 I=2,6
      EF(I,GRADE,PROG)=ENROL*(TE(I,GRADE)/(TE(1,GRADE)*1.))
   75 TOTEF(I,GRADE,PROG)=TOTEF(I,GRADE,PROG)+EF(I,GRADE,PROG)
C     GO BACK AND READ NEXT INPUT CARD
      GO TO 20
  202 SCHOOL=ESCH
      DO 203 ISN=1,7
  203 SAVNAM(ISN)=SCHNAM(ISN)
      GO TO 24
C     OUTPUT SECTION: FIRST CALCULATE ENROLLMENTS FOR GRADE GROUPS
 1000 DO 1010 PR=1,NOPROG
      DO 1010 YR=1,6
      DO 1010 GR=2,7
      INDX=EF(YR,GR,PR)
      IF(GR.GE.2.AND.GR.LE.3) GO TO 1011
10111 IF(GR.GE.4.AND.GR.LE.7) GO TO 1012
10112 IF(GR.GE.2.AND.GR.LE.7) GO TO 1013
10113 IF(GR.GE.2.AND.GR.LE.4) GO TO 1014
10114 IF(GR.GE.5.AND.GR.LE.7) GO TO 1015
      GO TO 1010
 1011 EF(YR,9,PR)=EF(YR,9,PR)+INDX
      TOTEF(YR,9,PR)=TOTEF(YR,9,PR)+INDX
      GO TO 10111
 1012 EF(YR,12,PR)=EF(YR,12,PR)+INDX
      TOTEF(YR,12,PR)=TOTEF(YR,12,PR)+INDX
      GO TO 10112
 1013 EF(YR,11,PR)=EF(YR,11,PR)+INDX
```

```
      TOTEF(YR,11,PR)=TOTEF(YR,11,PR)+INDX
      GO TO 10113
 1014 EF(YR,10,PR)=EF(YR,10,PR)+INDX
      TOTEF(YR,10,PR)=TOTEF(YR,10,PR)+INDX
      GO TO 10114
 1015 EF(YR,13,PR)=EF(YR,13,PR)+INDX
      TOTEF(YR,13,PR)=TOTEF(YR,13,PR)+INDX
 1010 CONTINUE
C   WRITE OUT TABLES BY GRADE FOR ONE SCHOOL
      WRITE(6,3) SCHOOL,SAVNAM
    3 FORMAT('1',20X,I6,1X,6A4,A1)
      LINCT=0
      DO 1090 I=1,13
      IG=I+5
      IF(.NOT.FLAGS(I))GO TO 1080
      IF(LINCT.GE.2) GO TO 1090
 1040 IF(I.EQ.1) WRITE(6,4)
    4 FORMAT('0ELEMENTARY')
      IF(I.GE.2.AND.I.LE.7) WRITE(6,5) IG
    5 FORMAT('0',I2,' GRADE')
      IF(I.EQ.8) WRITE(6,6)
    6 FORMAT('0POST SECONDARY')
      IF(I.EQ.9) WRITE(6,7)
    7 FORMAT('07-8 GRADE')
      IF(I.EQ.12) WRITE(6,8)
    8 FORMAT('09-12 GRADE')
      IF(I.EQ.11) WRITE(6,9)
    9 FORMAT('07-12 GRADE')
      IF(I.EQ.10) WRITE(6,11)
   11 FORMAT('07-9 GRADE')
      IF(I.EQ.13) WRITE(6,12)
   12 FORMAT('010-12 GRADE')
      Y5=CY+5
      WRITE(6,13) (YR,YR=CY,Y5)
   13 FORMAT('0PROGRAM',15X,6I10/)
      LINCT=LINCT+1
      DO 1051 PR=1,NZPROG
      IF(EF(1,I,PR).EQ.0) GO TO 1051
      WRITE(6,14)(PRNY(PR,J),J=1,3),(EF(YR,I,PR),YR=1,6)
   14 FORMAT(' ',A5,1X,2A8,6I10)
      DO 1050 YR=1,6
      TOTPR(YR)=TOTPR(YR)+EF(YR,I,PR)
 1050 CONTINUE
 1051 CONTINUE
      WRITE(6,16)(TOTPR(YR),YR=1,6)
   16 FORMAT('0TOTAL',17X,6I10/)
      DO 1055 JJ=1,6
 1055 TOTPR(JJ)=0
      GO TO 1080
 1090 WRITE(6,3) SCHOOL,SAVNAM
      LINCT=0
      GO TO 1040
 1080 CONTINUE
C   IF NO MORE DATA GO TO TOTAL SECTION OTHERWISE RE-INITIALIZE VARIABLES
C   AND GO ON TO STORE NEXT RECORD
      IF(ENDJ) GO TO 2000
      SCHOOL=FSCHL
      DO 1087 ISN=1,7
 1087 SAVNAM(ISN)=SCHNAM(ISN)
      DO 1088 YR=1,6
      DO 1088 GR=1,13
```

```
      DO 1088 PR=1,NOPROG
 1088 EF(YR,GR,PR)=0
      DO 1099 I=1,13
 1099 FLAGS(I)=.FALSE.
      GO TO 24
C  OUTPUT TOTEF, TABLE FOR EACH GRADE
 2000 WRITE(6,300)
  300 FORMAT('1',20X,'TOTAL FOR ALL SCHOOLS')
      LINCT=0
      DO 2080 I=1,13
      IG=I+5
      IF(LINCT.GE.2) GO TO 2090
 2040 IF(I.EQ.1) WRITE(6,4)
      IF(I.GE.2.AND.I.LE.7) WRITE(6,5) IG
      IF(I.EQ.8) WRITE(6,6)
      IF(I.EQ.9) WRITE(6,7)
      IF(I.EQ.10) WRITE(6,11)
      IF(I.EQ.11) WRITE(6,9)
      IF(I.EQ.12) WRITE(6,8)
      IF(I.EQ.13) WRITE(6,12)
      Y5=CY+5
      WRITE(6,13)(YR,YR=CY,Y5)
      LINCT=LINCT+1
      DO 2050 PR=1,15
      WRITE(6,14) (PRNY(PR,J),J=1,3),(TOTEF(YR,I,PR),YR=1,6)
      DO 2050 YR=1,6
      TOTPR(YR)=TOTPR(YR)+TOTEF(YR,I,PR)
 2050 CONTINUE
      WRITE(6,16)(TOTPR(YR),YR=1,6)
      DO 2055 JJ=1,6
 2055 TOTPR(JJ)=0
      GO TO 2080
 2090 WRITE(6,300)
      LINCT=0
      GO TO 2040
 2080 CONTINUE
C CALCULATE TOTAL FOR ALL GRADES AND OUTPUT TGREF
      DO 3000 GR=1,13
      DO 3000 YR=1,6
      DO 3000 PR=1,NOPROG
      TGREF(YR,PR)=TGREF(YR,PR)+TOTEF(YR,GR,PR)
      TOTPR(YR)=TOTPR(YR)+TGREF(YR,PR)
 3000 CONTINUE
      WRITE(6,301)
  301 FORMAT('1'/////20X,'TOTAL FOR ALL SCHOOLS AND ALL GRADES')
      Y5=CY+5
      WRITE(6,13)(YR,YR=CY,Y5)
      DO 3050 PR=1,NOPROG
      WRITE(6,14) (PRNY(PR,J),J=1,3),(TGREF(YR,PR),YR=1,6)
 3050 CONTINUE
      WRITE(6,16)(TOTPR(YR),YR=1,6)
      STOP
 2002 ENDJ=.TRUE.
      GO TO 1000
      END
```

```
[illegible] DISTRICT      RUN JULY,1972                                   CURRENT-YEAR= 1972        PAGE  1

        PERSISTENCE RATES BY AGE GROUP   (1 THROUGH 6)
  0.9957  0.9930  0.9926  0.9800  0.9700  0.9910

        PEOPLE-PER-ADDED-HOUSEHOLD BY AGE GROUP  (1-6)
  [illegible]  0.5000  0.6000  0.4500  0.3000  3.9000 SINGLE-FAMILY
  [illegible]  0.1500  0.1500  0.0800  0.0300  2.8000 MULTI-FAMILY

        ENROLLMENT OPERATORS BY AGE-GROUP-INDEX (1-3)
  0.2000  0.0     0.0     GRADEX  1
  0.1964  0.0011  0.0012  GRADEX  2
  0.1260  0.0021  0.0025  GRADEX  3
  0.1437  0.0127  0.0027  GRADEX  4
  0.1259  0.0749  0.0014  GRADEX  5
  [illegible]  0.1901  0.0012  GRADEX  6
  0.0011  0.1923  0.0028  GRADEX  7
  0.0001  0.1650  0.0083  GRADEX  8
  0.0     0.1700  0.0230  GRADEX  9
  0.0     0.1300  0.0654  GRADEX 10
  0.0     0.0200  0.1400  GRADEX 11
  0.0     0.0070  0.1370  GRADEX 12
  0.0     0.0004  0.1300  GRADEX 13
  0.0     0.0     0.0444  GRADEX 14

        CY-1 POPULATION BY AGE GROUP (1-6)
  [illegible]  4345  4540  4445  3479 42585

        COMMUNITY ENROLLMENTS BY GRADE-INDEX (1-15)
  452  843  843  874  834  797  768  754  746  737  740  678  629  155   0 1967
  871  882  861  909  850  827  802  786  776  760  743  680  629  155   0 1968
  890  879  882  914  896  862  836  819  806  783  746  691  624  155   0 1969
  910  935  931  940  911  936  870  851  836  806  750  682  623  154   0 1970

        PUBLIC ENROLLMENTS BY GRADE-INDEX (1-15)
  331  766  735  655  660  619  536  574  517  550  477  445  423    0   0 1967
  693  775  731  753  654  679  644  637  589  529  527  413  428    0   0 1968
  934  786  750  722  720  645  667  649  608  611  521  451  409    0   0 1969
  902  814  730  745  719  715  653  696  654  626  554  466  432    0   0 1970

        NEW-HOUSING FIGURES BY YEAR  (CY-7 THRU CY-3)
  207  151  133  147  141 SINGLE-FAMILY
   12  156  694  824  340 MULTI-FAMILY
```

Chart VII-3

Example Printout - COMENR

```
SAMPLE DISTRICT      RUN JULY,1972                              CURRENT-YEAR= 1972        PAGE  2

        HOUSING SUPPLY CY-2:  SINGLE-FAMILY  MULTI-FAMILY
                                  11038        2462

        HOUSING RULE IN CY-2:    2
        EXPECTED NEW SINGLE-FAMILY HOUSING FOR CY-2:   140

        ACTUAL NEW SINGLE-FAMILY HOUSING FOR CY-2:    244
        ACTUAL NEW  MULTI-FAMILY HOUSING FOR CY-2:    516

        BIRTHS FOR CY-2:   839

        PUBLIC ENROLLMENT BY GRADE-INDEX FOR CY-1
   175  810  750  720  730  705  710  724  706  625  585  524  441    6    0

        OVERRIDE INPUT FOR NEW-HOUSING FIGURES BY YEAR
             IN YEARS CY-1 THROUGH CY+5
   550  630  610  610  600  600  600 SINGLE-FAMILY
   350  680  780  780  780  800  800 MULTI-FAMILY

        NEW-HOUSING FIGURES BY YEAR:  CY-7 THRU CY+5
   207  151  136  142  141  244  550  630  610  610  600  600  500 SINGLE-FAMILY
    12  156  694  324  340  516  350  680  780  780  780  800  800 MULTI-FAMILY
```

SAMPLE DISTRICT [illegible] JULY, 1972

CURRENT-YEAR= 1972

AGE	1971	1972	1973	1974	1975	1976	1977
< 1	[illegible]	[illegible]	936	974	997	1062	1080
0 - 4	[illegible]	[illegible]	4649	5243	5500	5764	5994
5 - 9	[illegible]	[illegible]	5341	5695	6034	6349	6654
10 - 14	4544	4904	5108	5431	5755	6071	6383
15 - 19	3572	3941	4275	4512	4798	5080	5362
TOTAL	44556	47281	51179	55291	59346	63336	67346
E.P.[illegible]	[illegible]	19	18	18	17	17	16

HOUSING SUPPLY

SING.FAM	11337	11892	12492	13102	13712	14312	14912
MULT.FAM	2973	3328	4008	4788	5568	6348	7148
TOTAL	14310	15220	16500	17890	19280	20660	22060

SAMPLE DISTRICT ... RUN JULY,1972 ... CURRENT-YEAR= 1972 ...

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
ANNUAL HOUSING GAIN											
SING.FAM	138	142	141	244	560	600	610	610	600	600	600
MULT.FAM	694	824	340	516	350	680	780	780	780	800	800
COMMUNITY TOTAL ENROLLMENTS BY GRADE											
KINDGTN.	852	871	893	910	939	998	1068	1139	1207	1270	1331
GRADE 1	840	860	879	898	931	990	1060	1130	1197	1260	1320
2	843	863	882	901	939	998	1068	1139	1207	1270	1331
3	878	899	919	940	977	1038	1111	1184	1255	1321	1384
4	834	860	866	911	937	993	1061	1130	1197	1261	1323
5	793	827	862	896	918	969	1031	1096	1162	1225	1288
6	768	802	836	870	891	940	1000	1063	1127	1189	1250
7	754	796	819	851	873	922	981	1043	1105	1166	1226
8	746	775	806	836	859	907	966	1027	1089	1149	1208
9	737	760	783	806	832	882	940	1001	1062	1121	1180
10	740	743	746	750	789	845	905	966	1027	1087	1146
11	678	677	681	682	719	771	826	882	938	992	1047
12	629	627	623	628	663	711	763	814	866	917	968
P.G.	155	155	155	154	163	175	188	200	213	226	238
7- 8	1500	1542	1625	1687	1732	1829	1947	2070	2194	2315	2434
9-12	2784	2912	2838	2866	3003	3209	3434	3663	3893	4117	4341
7-12	4284	4374	4463	4553	4735	5038	5381	5733	6087	6432	6775
7- 9	2237	2322	2428	2493	2564	2711	2837	3071	3256	3436	3614
10-12	2047	2052	2055	2060	2171	2327	2494	2662	2831	2996	3161
PUBLIC ENROLLMENTS BY GRADE											
KINDGTN.	831	893	905	902	975	872	869	866	863	860	857
GRADE 1	766	775	783	814	810	819	823	816	807	797	790
2	723	731	750	738	750	792	808	808	796	790	766
3	645	753	722	749	720	768	820	834	829	810	789
4	660	654	720	719	730	724	777	826	835	825	803
5	619	679	645	715	705	744	740	791	838	843	831
6	586	644	667	653	710	724	770	765	815	860	862
7	574	637	649	696	724	763	744	832	824	872	915
8	517	585	608	654	706	742	789	810	858	846	893
9	550	575	611	626	675	724	763	816	836	882	867
10	477	527	521	554	585	612	720	766	914	833	879
11	444	413	451	466	524	557	563	637	729	771	787
12	423	428	409	432	441	525	558	582	682	720	759
P.G.	0	0	0	0	6	6	7	7	8	8	9
7- 8	1091	1326	1257	1350	1430	1505	1573	1642	1632	1718	1808
9-12	1494	1997	1992	2078	2175	2418	2629	2851	3061	3206	3292
7-12	2995	3123	3249	3428	3605	3923	4202	4493	4743	4924	5100
7- 9	1641	1755	1868	1976	2095	2229	2341	2458	2518	2600	2675
10-12	1344	1368	1381	1452	1550	1694	1861	2035	2225	2324	2425

RIC. JULY,1972 CURRENT-YEAR= 1972 PAGE 5

NINTH... PUBLIC ROLL AS % OF COMMUNITY ROLL
AND SUCCESSION RATES AND TRANSFERS...

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	AVE	S.D.
KINDGTN.	97.54	102.53	101.57	99.12	93.18	0.0	0.0	0.0	0.0	0.0	0.0		
KINDGTN.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
KINDGTN.	*******	62.00	11.00	-2.00	-27.00	-875.00	********	********	********	********	********	-3.00	27.74
GRADE 1	91.19	90.12	89.65	90.65	87.00	82.73	77.64	72.21	57.42	63.25	59.85		
GRADE 1	100.00	100.94	100.92	100.90	102.31	105.43	106.21	105.81	105.09	104.39	103.94		
GRADE 1	*******	-63.80	-113.20	-98.13	-112.81	********	********	********	********	********	********	-103.58	15.63
2	86.95	84.70	85.03	81.91	79.87	79.36	75.66	70.94	65.95	61.42	57.55		
2	100.00	102.74	102.56	102.50	104.57	107.70	107.88	107.45	106.81	106.10	105.63		
2	*******	-56.97	-44.82	-69.72	-101.16	********	********	********	********	********	********	-75.94	23.56
3	71.46	93.76	73.56	79.63	73.69	73.99	73.81	70.44	66.06	61.32	57.01		
3	100.00	106.64	106.49	106.58	108.44	110.54	111.32	110.86	110.18	109.44	108.98		
3	*******	-28.69	-56.43	-50.32	-80.25	********	********	********	********	********	********	-61.35	17.98
4	79.14	76.05	81.26	78.92	77.91	72.91	73.23	73.10	69.76	65.42	60.70		
4	100.00	97.95	98.55	99.13	99.68	101.64	102.22	101.71	101.10	100.48	100.15		
4	*******	22.22	-22.11	3.29	-16.61	********	********	********	********	********	********	-7.86	14.87
5	73.36	82.10	74.83	79.80	76.80	76.78	71.77	72.17	72.12	68.82	64.52		
5	100.00	99.16	100.23	101.13	100.77	103.42	103.83	103.30	102.93	102.34	102.14		
5	*******	24.54	-10.52	-13.13	-19.52	********	********	********	********	********	********	-11.40	13.19
6	76.30	80.30	82.18	75.06	79.69	77.02	77.00	71.97	72.32	72.33	68.96		
6	100.00	101.13	101.09	100.93	99.44	102.40	103.20	103.10	102.83	102.32	102.04		
6	*******	17.98	0.61	2.01	-1.01	********	********	********	********	********	********	2.12	5.73
7	76.13	81.04	79.24	81.79	82.93	82.75	79.92	79.77	74.57	74.79	74.63		
7	100.00	102.34	102.12	101.79	100.34	103.48	104.36	104.30	103.95	103.46	103.11		
7	*******	37.27	-8.65	-3.33	68.75	********	********	********	********	********	********	28.50	37.05
8	69.30	75.90	75.43	78.23	82.19	81.81	81.66	78.87	78.79	73.63	73.92		
8	100.00	102.92	102.54	102.08	100.94	103.89	104.77	104.69	104.41	103.98	103.60		
8	*******	-1.75	-45.21	-8.47	3.46	********	********	********	********	********	********	-10.37	19.08
9	74.63	69.61	78.03	77.67	75.12	82.09	81.70	81.52	78.72	78.68	73.47		
9	100.00	101.88	100.90	100.00	99.52	102.68	103.64	103.62	103.41	102.94	102.70		
9	*******	2.30	16.69	18.00	-25.87	********	********	********	********	********	********	-1.38	21.58
10	64.46	70.93	69.94	73.87	74.14	72.43	79.55	79.30	79.26	76.63	76.70		
10	100.00	100.81	98.16	95.79	97.89	101.56	102.61	102.77	102.60	102.35	102.23		
10	*******	-27.48	1.75	-31.25	-27.90	********	********	********	********	********	********	-22.89	13.08
11	65.49	60.74	66.23	68.33	72.89	72.24	70.58	77.89	77.72	77.72	75.17		
11	100.00	91.89	91.66	91.42	95.87	97.72	97.75	97.46	97.10	96.59	96.32		
11	*******	-25.32	-32.02	-10.30	-7.10	********	********	********	********	********	********	-14.87	10.55
12	67.25	68.04	65.13	68.79	66.52	73.84	73.13	71.50	78.75	78.52	78.41		
12	100.00	92.77	92.35	92.22	97.21	98.89	98.95	98.55	98.19	97.76	97.58		
12	*******	16.09	27.58	16.10	-12.02	********	********	********	********	********	********	7.15	17.08
[illegible]	0.0	0.0	0.0	0.0	3.68	3.68	3.68	3.63	3.63	3.68	3.68		
[illegible]	100.00	24.64	24.64	24.52	25.96	100.00	100.00	100.00	100.00	100.00	100.00		
[illegible]	*******	-104.24	-105.47	-100.30	-106.13	********	********	********	********	********	********	-104.06	2.66

SA LE DISTRICT RUN JULY, 1972 CURRENT-YEAR= 1972 PAGE 6

SUCCESSION RATES BY GRADE (READ DIAGONALLY)

```
FROM
    KINDGTN.   **************
    GRADE  1   **********************
           2   ***************************
           3   **********************************
           4   ********************************** 100.00
           5   ********************************** 100.00 102.21
           6   ********************************** 100.00 103.49 105.66
           7   ********************************** 100.00 108.29 111.83 113.81
           8   ********************************** 100.00 103.41 111.88 115.32 116.85
           9   ********************************** 100.00 103.50 106.95 115.47 118.55 119.75
          10   ********************************** 100.00  99.45 103.23 106.68 115.06 118.15
          11   ********************************** 100.00  95.26  94.89  98.25 101.05 108.70
          12   ********************************** 100.00 100.13  95.10  94.20  97.04  99.48
```

1 SAMPLE DISTRICT-SCHOOL 1

10 GRADE

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	55	64	68	73	74	78
01400 OFFICE OCCUPATIO	170	199	212	226	231	244
TOTAL	225	263	280	299	305	322

11 GRADE

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	11	11	13	14	15	15
00902 CLOTHING TECHNOL	13	13	16	17	17	18
01400 OFFICE OCCUPATIO	141	147	173	184	195	199
01703 AUTO MECHANICS	16	16	19	20	22	22
01710 BUILDING TRADES	20	20	24	26	27	28
01713 DRAFTING	17	17	20	22	23	24
01714 ELECTRICAL TRADE	16	16	19	20	22	22
01719 PRINTING TRADES	25	26	30	32	34	35
01723 MACHINE TRADES	27	29	33	35	37	38
01726 COSMETOLOGY	30	31	37	39	41	42
01729 COMMERCIAL FOODS	18	18	22	23	24	25
TOTAL	334	343	406	432	457	469

Chart VII-4
Example Printout - VOCEDENR

1 SAMPLE DISTRICT-SCHOOL 1

9-12 GRADE

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	110	121	129	144	149	156
00709 HEALTH SERVICES	18	19	19	23	24	26
00902 CLOTHING TECHNOL	23	23	27	29	30	32
01400 OFFICE OCCUPATIO	362	400	441	476	495	516
01703 AUTO MECHANICS	33	34	37	42	45	46
01710 BUILDING TRADES	44	45	50	57	59	62
01713 DRAFTING	36	37	41	46	49	51
01714 ELECTRICAL TRADE	39	40	44	49	53	55
01719 PRINTING TRADES	44	46	51	56	60	62
01723 MACHINE TRADES	42	43	49	54	57	59
01726 COSMETOLOGY	60	62	70	77	82	85
01729 COMMERCIAL FOODS	31	31	36	39	41	43
TOTAL	842	901	994	1092	1144	1193

10-12 GRADE

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	110	121	129	144	149	156
00709 HEALTH SERVICES	18	19	19	23	24	26
00902 CLOTHING TECHNOL	23	23	27	29	30	32
01400 OFFICE OCCUPATIO	362	400	441	476	495	516
01703 AUTO MECHANICS	33	34	37	42	45	46
01710 BUILDING TRADES	44	45	50	57	59	62
01713 DRAFTING	36	37	41	46	49	51
01714 ELECTRICAL TRADE	39	40	44	49	53	55
01719 PRINTING TRADES	44	46	51	56	60	62
01723 MACHINE TRADES	42	43	49	54	57	59
01726 COSMETOLOGY	60	62	70	77	82	85
01729 COMMERCIAL FOODS	31	31	36	39	41	43
TOTAL	842	901	994	1092	1144	1193

2 SAMPLE DISTRICT-SCHOOL 2

10 GRADE

PROGRAM	72	73	74	75	76	77
11400 OFFICE OCCUPATIO	80	94	100	106	108	114
TOTAL	80	94	100	106	108	114

11 GRADE

PROGRAM	72	73	74	75	76	77
11400 OFFICE OCCUPATIO	115	120	141	150	159	162
11703 AUTO MAINTENANCE	19	19	23	24	26	26
11710 BUILDING TRADES	11	11	13	14	15	15
11713 DRAFTING	13	18	22	23	24	25
TOTAL	163	168	199	211	224	228

TOTAL FOR ALL SCHOOLS

10 GRADE

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	55	64	68	73	74	78
00709 HEALTH SERVICES	0	0	0	0	0	0
00902 CLOTHING TECHNOL	0	0	0	0	0	0
01400 OFFICE OCCUPATIO	170	199	212	226	231	244
01703 AUTO MECHANICS	0	0	0	0	0	0
01710 BUILDING TRADES	0	0	0	0	0	0
01713 DRAFTING	0	0	0	0	0	0
01714 ELECTRICAL TRADE	0	0	0	0	0	0
01719 PRINTING TRADES	0	0	0	0	0	0
01723 MACHINE TRADES	0	0	0	0	0	0
01726 COSMETOLOGY	0	0	0	0	0	0
01729 COMMERCIAL FOODS	0	0	0	0	0	0
11400 OFFICE OCCUPATIO	89	94	100	106	108	114
11703 AUTO MAINTENANCE	0	0	0	0	0	0
11710 BUILDING TRADES	0	0	0	0	0	0
TOTAL	305	357	380	405	413	436

11 GRADE

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	11	11	13	14	15	15
00709 HEALTH SERVICES	0	0	0	0	0	0
00902 CLOTHING TECHNOL	13	13	16	17	17	18
01400 OFFICE OCCUPATIO	141	147	173	184	195	199
01703 AUTO MECHANICS	16	16	19	20	22	22
01710 BUILDING TRADES	20	20	24	26	27	28
01713 DRAFTING	17	17	20	22	23	24
01714 ELECTRICAL TRADE	16	16	19	20	22	22
01719 PRINTING TRADES	25	26	30	32	34	35
01723 MACHINE TRADES	27	28	33	35	37	38
01726 COSMETOLOGY	30	31	37	39	41	42
01729 COMMERCIAL FOODS	18	18	22	23	24	25
11400 OFFICE OCCUPATIO	115	120	141	150	159	162
11703 AUTO MAINTENANCE	19	19	23	24	26	26
11710 BUILDING TRADES	11	11	13	14	15	15
TOTAL	479	463	583	620	657	671

TOTAL FOR ALL SCHOOLS AND ALL GRADES

PROGRAM	72	73	74	75	76	77
00499 DISTRIBUTIVE EDU	440	484	516	576	596	624
00702 HEALTH SERVICES	72	76	76	92	96	104
00902 CLOTHING TECHNOL	92	92	108	116	120	128
01400 OFFICE OCCUPATIO	1448	1600	1764	1904	1980	2064
01703 AUTO MECHANICS	132	136	148	168	180	184
01710 BUILDING TRADES	176	180	200	228	236	248
01713 DRAFTING	144	148	164	184	196	204
01714 ELECTRICAL TRADE	156	160	176	196	212	220
01719 PRINTING TRADES	176	184	204	224	240	248
01723 MACHINE TRADES	168	172	196	216	228	236
01726 COSMETOLOGY	240	248	280	308	328	340
01729 COMMERCIAL FOODS	124	124	144	156	164	172
11400 OFFICE OCCUPATIO	864	944	1056	1132	1180	1224
11703 AUTO MAINTENANCE	76	76	92	96	104	104
11711 BUILDING TRADES	44	44	52	56	60	60
11713 DRAFTING	144	148	164	184	192	204
11726 COSMETOLOGY	0	0	0	0	0	0
TOTAL	15719	16877	18720	20420	21371	22251

```
DATA PRINTOUT:  COMENR
(GRADE HEADINGS:)
KINDGIN- GRADE 1        2       3       4       5       6       7       8       9
     10      11      12     E.G.    7- 8    9-12    7-12    7- 9   10-12
     SAMPLE DISTRICT        RUN JULY,1972          (RUN HEADING)
1972 (CURRENT FISCAL YEAR)
 .9657   .9930   .9926   .5800   .5700   .9910  (PERSISTENCE RATES)
 .052 .500 .600 .450 .300 3.50 } (PEOPLE-PER-ADDED HOUSEHOLD)
 .026 .150 .150 .080 .030 2.80 }
   .2000    .0000    .0000  ]
   .1964    .0011    .0012  ]
   .1960    .0021    .0025  ]
   .1937    .0127    .0027  ]
   .1259    .0749    .0014  ]
   .0098    .1901    .0018  ]
   .0011    .1923    .0028  ]  (ENROLLMENT OPERATORS)
   .0001    .1850    .0083  ]
   .0       .17      .0230  ]
   .0000    .1300    .0654  ]
   .0000    .0200    .1900  ]
   .0000    .0070    .1870  ]
   .0000    .0004    .1800  ]
   .0000    .0000    .0444  ]
  830  4345  4549  4445  3479 42555    (POPULATION)
  852  840  843  878  834  793  768  754  746  737  740  678  629  155 }
  871  860  863  899  860  827  802  786  775  760  743  680  629  155 }  (COMMUNITY ENROLLMENTS)
  890  879  882  919  886  862  836  819  806  783  746  681  628  155 }
  910  898  901  940  911  856  870  851  836  806  750  682  628  154 }
  831  766  733  645  606  619  556  574   17  550  477  444  423    0 }
  893  775  731  753  654  579  644  637  563  529  527  413  428    0 }  (PUBLIC ENROLLMENTS)
  904  788  750  722  720  645  687  649  608  611  521  451  409    0 }
  902  814  733  749  715  715  653  696  694  626  554  466  432    0 }
  207  151  138  142  141 }
   12  156  694  824  340 }  (NEW HOUSING)
11088  2462      (HOUSING SUPPLY CY-2)
    2   140    (HOUSING RULE & EXPECTED NEW HOUSING FOR CY-2)
  244   516    (ACTUAL NEW HOUSING CY-2)
  839          (BIRTHS CY-2)
  875  810  750  720  730  705  710  724  706  625  565  524  441    6   (PUBLIC ENROLL. CY-3)
OVRRIDE--
  560  600  610  610  600  600  600 }  (OVERRIDE INPUT FOR NEW HOUSING FIGURES
  350  680  780  780  780  800  800 }   CY-1 - CY-5)
```

Chart VII-5

Data Printout-COMENR

DATA PRINTOUT: VOCEDENR

Current Fiscal Yr.	School Dist. #	Dist. &/or School Name	Gr.	Prog.	Enrollment
72	1	SAMPLE DISTRICT-SCHOOL 1	10	00499	55
72	1	SAMPLE DISTRICT-SCHOOL 1	11	00499	11
72	1	SAMPLE DISTRICT-SCHOOL 1	12	00499	44
72	1	SAMPLE DISTRICT-SCHOOL 1	12	00709	18
72	1	SAMPLE DISTRICT-SCHOOL 1	11	00902	13
72	1	SAMPLE DISTRICT-SCHOOL 1	12	00902	10
72	1	SAMPLE DISTRICT-SCHOOL 1	10	01400	170
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01400	141
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01400	51
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01703	16
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01703	17
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01710	20
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01710	24
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01713	17
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01713	19
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01714	16
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01714	23
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01719	25
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01719	19
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01723	27
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01723	15
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01726	30
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01726	30
72	1	SAMPLE DISTRICT-SCHOOL 1	11	01729	18
72	1	SAMPLE DISTRICT-SCHOOL 1	12	01729	13
72	2	SAMPLE DISTRICT-SCHOOL 2	10	11400	50
72	2	SAMPLE DISTRICT-SCHOOL 2	11	11400	115
72	2	SAMPLE DISTRICT-SCHOOL 2	12	11400	21
72	2	SAMPLE DISTRICT-SCHOOL 2	11	11703	15
72	2	SAMPLE DISTRICT-SCHOOL 2	12	11703	00
72	2	SAMPLE DISTRICT-SCHOOL 2	11	11710	11
72	2	SAMPLE DISTRICT-SCHOOL 2	12	11710	00
72	2	SAMPLE DISTRICT-SCHOOL 2	11	11713	18
72	2	SAMPLE DISTRICT-SCHOOL 2	12	11713	18
72	2	SAMPLE DISTRICT-SCHOOL 2	11	11726	00
72	2	SAMPLE DISTRICT-SCHOOL 2	12	11726	00

OVERRIDE TOTAL PUBLIC SCHOOL ENROLLMENT FIGURES

5000	5500	6000	6500	6500	6500
922	931	1043	1105	1166	1226
907	966	1027	1089	1149	1208
882	940	1001	1062	1121	1180
845	905	966	1027	1087	1146
771	826	882	938	992	1047
711	763	814	866	917	968
175	188	200	213	226	238

Chart VII-5

Data Printout-VOCEDENR

APPENDIX A

Edited by Robert E. Coughlin

Research Report

MOBILITY ANALYSIS

Arnold R. Post

Mobility analysis is described as a technique more useful in small area demography than traditional methods which rely on concepts of natural increase and net migration. The proposed model relates to observations that in the absence of new housing construction, local populations are likely to decrease. The advantages of traditional analysis in dealing with development of age distributions are preserved.

Population analysis often seeks to estimate the impact of major components of population growth for a given place. These components are usually considered: *natural increase*, resulting from births and deaths of people; and *net migration*, resulting from their comings and goings. Traditional cohort-survival methods of analysis treat these components as though they were independently generated in time (natural increase) and space (net migration). In areas as small as or smaller than a metropolitan area, this treatment may be quite deceptive.

Traditional analysis defines primary clusters of people by *geographic unit*. An alternate approach, "mobility analysis," considers the *household* to the primary population cluster. Geographic analysis, however, may be done in terms of households so that, for a given area, mobility analysis offers a method of simultaneously working conditional demographic solutions in time and space.

The first part of this paper identifies elementary flaws in the logic of cohort-survival analysis and points up a seldom noted difference in naturalization procedures that makes a simple joining of census returns and vital statistics invalid for small areas. The second part of this paper describes the nature of mobility analysis. Thirdly, a conjectural analysis is developed as a basis for judging the reasonableness of statistics that have been derived. The fourth part outlines the major stages in calculation and presents some statistical findings.

Categories and Shortcomings of Traditional Analysis

Meyer Zitter and Henry S. Shryock [1] performed yeoman service when they applied the U.S. Census Bureau's Component Method II to arrive at their estimate of the known 1960 populations of forty-six large metropolitan areas on the basis of 1950 census returns and later data on vital statistics and school enrollments. Their findings revealed a marked downward bias in the estimates and some rather large individual errors relating in particular to the population under ten-years-old. Although the authors took a dim view of their findings, they did not question the basic concepts employed. These findings, I think, do relate to conceptual shortcomings.

Component methods imply two categories of people: natural resident and migrant. Regarding the components of growth they generate, a standard text [2] puts it this way: "Migration is not considered in the calculation of natural increase. In 1960, the United States had a natural increase (which excludes migration) of 2,545,000 because . . ." births exceeded deaths by this amount.

Actually, of course, the same types of vital events happen to people of both classes. The treatment of migrants as sterile and immortal constitutes one elementary flaw in the logic of cohort-survival methods. The second basic flaw, which is apparent at the small area level, is failure to allow for attrition among natural residents as they enter the migrant category.

Now, if people become migrants by moving about, it is clear that there must be some procedure by which migrants become natural residents again. Otherwise, we would have run out of natural residents long ago. Migrants are naturalized when determination is made of their proper place of residence. There are two procedures for migrant naturalization: (1) census takers naturalize the population, all at once, every ten years; and (2) vital statisticians naturalize persons individually and immediately on the report of a vital event. Since migrants, too, bear children, the honest demographer has difficulty in applying the concept of natural increase to anticipate the census taker when the vital statistician supplies the data.

Exception is taken here to the standard definition quoted above. The generally recognized problem for demographers in estimating net migration is actually part of an equally difficult problem in estimating natural increase. It would foster greater accuracy to redefine natural increase, taking migration *into* consideration. The information system required to make the definition operational, however, would have to be highly complex.

Alternatively, it may be more reasonable to apply a different rationale, particularly since, at the local level,

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net migration is constrained by land use patterns, which are not sufficiently reflected in traditional analysis. Housing unit methods of estimate are sensitive to these constraints, but they do not yield age distributions.

The Nature of Mobility Analysis

Mobility analysis is, by and large, a synthesis of component and housing unit methods of estimate. The technique is based on the insights of Robert M. Reams, supervisor of many special municipal censuses conducted by the U. S. Census Bureau in 1957 and 1958.

Reams had taken part in the New York City census of 1957, which revealed a completely unexpected loss of population since 1950, especially in Manhattan. Careful investigation showed that many of the same families were still living in Manhattan but their children had moved to the suburbs. From this, Reams surmised that current population should be estimated by making some routine discount on the last known census return with an adjustment to be added to reflect changes in housing supply. Within his experience along most of the eastern seaboard, he found that 1958 special census returns were equal to about 90 percent of the 1950 population plus about 3.75 times housing supply change.

His insights have not gained currency, I suppose, because of their ad hoc nature and because they seem somewhat contrary to established notions. In estimating natural increase, it is assumed, to begin with, that the last censused population stays put. Since rates of natural increase are generally positive, there is a predisposition to expect positive growth trends if other things are equal. Reams' formula, on the other hand, would indicate that where the housing supply is quietly stable, a substantial decline of population is underway. There is actually a positive implication in the formula; but it is one that undermines the appropriateness of analysis by natural increase and migration. The positive implication is that a population over the course of time should be expected to spread out over a wider area—within or beyond a municipal boundary. This dispersion happens because of an increase in housing need caused by family formation; and this "natural increase in housing need" will contribute to outmigration if not locally satisfied.

Ream's formula is also in conflict with standard procedure for applying housing unit methods of estimate where the researcher establishes a trend for population per household, then estimates the number of households to arrive at an estimate of population. If Reams' formula is correct, the absence of a household gain implies a drop of about 10 percent in average population per household in the course of a decade. Other changes in population per dwelling would be specifically associated with particular changes in the number of households. The formula has the advantage of making allowance for the transfer of population from an original to an expanded housing supply. It is this allowance which unites space and time in the analysis.

Synthesis Probably the main difficulty with the concepts of natural increase and migration is that they do not provide a standard pattern of *local* population behavior. The concepts are person-specific and community specific, *respectively*. What seem to be needed are concepts that are community-specific *as well as* person-specific.

A person is related to a community by his residence; and places of residence offered by a community are highly community-specific. So long as almost all the population lives in households and so long as the vast majority of households occupy durable and immobile quarters, it is reasonable to define the number of households as a characteristic common both to the population and to the community.

Let a community be defined as declining, stable, or growing if the net change in number of households is negative, zero, or positive. Population changes in stable communities would then represent the degree to which population tends to persist in a given number of households. Further population changes associated with community instability would then be in terms of additional population per additional household, which is marginal change. Population growth would consist of two components: persistence and marginal change.

Conjectural Analysis

Net Parameters Janet Abu-Lughod and Mary Mix Foley [3] estimate on the basis of surveys made during the 1940's and 1950's that about 1 percent of the population in 1954–55 engaged in household formation. Presumably then, over the decade, stable communities would be left with $.99^{10}$ or about 89 percent of their initial household population. This figure should be approximately equal to a ten year persistence rate.

It is somewhat more difficult to draw a bead on average size of marginal household. Abu-Lughod and Foley indicate that change in family size is one of the most significant factors associated with household generation and taking new quarters. Positive changes are clearly the more pressing, and these come about mostly through marriage and birth.

Ned Shilling observes that the ratio of household heads in a cohort rises as the cohort ages and that for a given age-group the ratio over time is stable.[4] His research covers the period 1880 to 1950 and would appear to have been confirmed to a high degree in the census returns of 1960, at least those which I have inspected. The number of household heads generated by a cohort reaches a maximum by middle age since subsequent increases in headship ratio are more than offset by increases in the death rate. Eventually, of course, household heads vanish with extinction of the cohort. Since young children and their parents are associated with household increase, it is reasonable to expect average size of marginal household, that is,

TABLE 1 *Age-Specific Coefficients of Marginal Change, 1950–60 (Persons per household)*

1960 Age group	West Deptford approximation	Regression values [a]
0–4	.68 [b]	.665
5–9	.56 [b]	.560
10–14	.36	.356
15–19	.12	.307
20–24	.12	.359
25–29	.44	.376
30–34	.60	.354
35–39	.40	.340
40–44	.28	.254
45–49	.16	.173
50–54	.12	.141
55–59	.12	.094
60–64	.04	.047
65–on	—.00	.120
Total	4.00	4.146

[a] From analysis of a random sample of 20 Pennsylvania Counties.
[b] Migrants under 10 years of age were estimated in proportion to migrant adults of child-bearing age, the proportions being taken for the Township's total 1960 age distribution.

coefficient of marginal change, to have a value higher than average population per family. In 1967, average family size in the United States [5] was 3.70, up slightly from 1960's average of 3.67. We can expect the coefficient of marginal change to have a value at least this high.

Since household generation is most closely associated with young adults, we should expect this coefficient to have a value less than the average for all families at or approaching maturity. In the source referred to, the Census Bureau reports an average of 4.38 persons for husband-wife families with the husband under 45. We can therefore expect the coefficient of marginal change to lie in a range between 3.7 and 4.4; and the principle of insufficient reason bids us take a round number in the middle, leading to a conjectural estimate of 4 persons per marginal household.

Thus, we have fashioned a rule of thumb that corresponds well with Reams' formula for estimating populations of small areas. If $P(t)$ refers to population at time of most recent census; $P(t\text{-}10)$ to population at time of previous census; and dH, to change in number of households at the interim, we have

$$P(t) = .89\ P(t\text{-}10) + 4\ dH. \qquad (1)$$

This rule of thumb is not significantly different from findings by multiple linear regression utilizing data from census tracts in the Philadelphia Standard Metropolitan Statistical Area. See relation (2) below.

Practical Considerations If the relation holds in a general way, it does much to simplify analysis of local population trends since the increase in households represents the only unknown to be defined. Building permit and school census information may be pertinent, if the data are of high quality. School enrollments, themselves, may constitute the best information on local population trends. Using the enrollment data and census cross-tabulations of school children by age and grade, a relationship between enrollment trends and net change in households can be found.

A distinct practical advantage offered by this method of analysis is that lay people find change in housing supply a familiar and pertinent variable and can relate it to contexts of building activity and land use constraints.

Age-Specific Parameters To return to more general matters, since headship ratios are age-specific and stable and since the processes of household generation are also age-related, it is not unreasonable to expect persistence rates and marginal changes to be age-specific. We should expect low persistence rates among teenagers (about to set up housekeeping for themselves) and higher persistence rates among children and young adults. The highest persistence rates may well be among the middle-aged, whose household heads remain nearly constant for ten to fifteen years, or so.

In small communities experiencing rapid population growth, one might expect the relative age distributions of marginal changes and net migratory increments to approximate each other. If so, then application of the percentage age distribution of the net-migratory increments to a base of 4.0 (the conjecturally estimated average population per marginal household) should yield an approximation of age-specific coefficients of marginal change.

The net-migratory age distribution for West Deptford Township, Gloucester County, New Jersey, is typical of the suburban townships in the development fringe of the Philadelphia area. The Township increased in population from 5,446 to 11,152 between 1950 and 1960. Table 1 offers a comparison between information derived from the Township's data and findings from regressions on a sample of twenty randomly selected counties in Pennsylvania, most of them rural and several of them losers of population. The chief differences are among teenagers and young adults, groups that are presumably subject to particularly low persistence rates, and among the elderly. The latter may relate to a lack of apartment development in the Township during the 1950's.

Persistence rates were simultaneously derived from the regressions on the random sample of twenty counties. These are compared with national survival rates in Table 2. Application of persistence rates should define a residual population in a stable community. It is reasonable to assume that the processes of dying and movement to new quarters are independent within a particular age group, that is, if a person is ten-years-old, his prospects of survival are not apt to be greatly altered by the family's taking new quarters. Thus, an age-specific persistence rate can be taken as the product of the appropriate survival rate and a "net remaining"

TABLE 2 *Age-Specific Per Capita Rates, 1950–60*

Age group	Survival rate [a] (a)	Peristence rate [b] (b)	Net remaining rate $(c=b/a)$	Death rate [c] $(1-a)$	Net departing rate $(1-c)$
0–4	1.020	.818	.802	−.020	.198
5–9	.988	.751	.761	.012	.239
10–14	.962	.575	.598	.038	.402
15–19	.991	.635	.641	.009	.359
20–24	1.044	.739	.708	−.044	.292
25–29	.996	.754	.757	.004	.243
30–34	.989	.798	.807	.011	.193
35–39	.950	.829	.873	.050	.127
40–44	.929	.803	.864	.071	.136
45–49	.922	.807	.875	.078	.125
50–54	.859	.782	.910	.141	.090
55–59	.871	.756	.868	.129	.132
60–64	.790	.666	.843	.210	.157
65–on	.464	.408	.880	.536	.120

[a] Source: U.S., Bureau of the Census, *Current Population Report*, P-23, No. 15, March 12, 1965.
[b] From analysis of 20 Pennsylvania Counties.
[c] See note a.

TABLE 3 *Tentative Estimating Equations for Population by Age Group in 20 Pennsylvania Counties, 1950–1960*

Persons by age group 1960	=	Persistence rate times 1950 cohort	+	Population per household times household increment, 1950–60, (dH)
X_1 (0–4)	=	$\Sigma f_i(Y_i), i=2, \ldots, 7$	+	.665
X_2 (5–9)	=	$\Sigma f_i(Y_i), i=3, \ldots, 8$	+	.560
X_3 (10–14)	=	.818 Y_1 (0–4)	+	.356
X_4 (15–19)	=	.751 Y_2 (5–9)	+	.307
X_5 (20–24)	=	.575 Y_3 (10–14)	+	.359
X_6 (25–29)	=	.635 Y_4 (15–19)	+	.376
X_7 (30–34)	=	.739 Y_5 (20–24)	+	.354
X_8 (35–39)	=	.754 Y_6 (25–29)	+	.340
X_9 (40–44)	=	.798 Y_7 (30–34)	+	.254
X_{10} (45–49)	=	.829 Y_8 (35–39)	+	.173
X_{11} (50–54)	=	.803 Y_9 (40–44)	+	.141
X_{12} (55–59)	=	.807 Y_{10} (45–49)	+	.094
X_{13} (60–64)	=	.782 Y_{11} (50–54)	+	.047
X_{14} (65–69)	=	.756 Y_{12} (55–59)	+	.041
X_{15} (70–74)	=	.666 Y_{13} (60–64)	+	.035
X_{16} (75–on)	=	.408 Y_{14} (65–on)	+	.044

Note: $f_i(Y_i)$ is the product of the i^{th} cohort's persistence rate, an age-specific birth rate, and the number of persons in the 1950 cohort. "Σ" indicates that these products are to be added together for the six indicated i-values. In the regression analysis, X_1 and X_2 were taken as functions of ΣY_i, $(i=2, \ldots, 14)$ and ΣY_i, $(i=3, \ldots, 14)$, respectively, in combination with dH, yielding generation rates of .091 and .096, for the first two 1960 cohorts. The determination of proper age-specific birth rates involves averaging over both time and age and has not been attempted in this research to date.

rate, with the complements of these rates being the death rate and a "net departing" rate. The application of net departing rates, then, should yield an age distribution of population generating what has been referred to as a "natural increase in housing need."

As can be seen in Table 2, persistence rates are much lower than survival rates. The negative death rates are an anomaly and relate to age groups where errors of underenumeration in the 1950 census were more significant than the actual death rate. The net departing rate is clearly of greater significance than the death rate for all age groups under forty-five. These two rates approximate each other for ages forty-five to sixty; and the death rate is more significant for the population over sixty.

If a community is losing households, then, it will generate an out-migratory stream, which would have two components: those in "natural need" of shelter and those whose needs are more nearly preferential. In a community gaining households, some of those in natural need (on net) would not enter the migratory stream. If enough households were added, none of the footloose population would be obliged to leave; and the net departing rate could then be termed a mobility rate. Such terminology would seem appropriate at the national level. "Mobility analysis" therefore suggests itself as a good name for procedures relying on these concepts of persistence and marginal change.

Statistical Findings and Estimating Procedure

Table 3 lists a first attempt at establishing age-specific parameters for mobility analysis. Each line of the table represents an estimating equation for the age group listed in the first column. Calculations proceed in five steps:

1. The age groups in the initial population are multiplied by the appropriate persistence rates to yield estimates of surviving population ten or more years old remaining in the initial number of households.
2. Age-specific birth rates modified to apply to populations of both sexes are applied to the residual population to estimate persistent population under ten.
3. An estimate is developed independently of the community's ten-year gain in households.
4. The coefficients of marginal change are each multiplied by the ten-year gain in households to provide an age distribution of population in the added households. (In view of the established change in birth rates since 1960, it may be desirable to modify the estimate of marginal population under ten-years-old.)
5. The two components are added together.

Data from the 427 census tracts outside the city of Philadelphia, but within the Philadelphia Standard Metropolitan Statistical Area (PSMSA) as of 1950, were also analyzed with respect to aggregate (non-age-specific) population and housing changes. The estimating equation for aggregate household population in occupied dwellings is only slightly different from the

TABLE 4 *Household Populations, 1960 (thousands)*

	Reported $P(1960)$	Estimated $.89\,P(1950) + 4.1\,dH$	Percentage error of estimate
PSMSA estimate[a]	4,206.1	4,146.1	−1.4[b]
Bucks, Pa.	304.9	300.9	−1.3
Chester, Pa.	198.6	195.2	−1.7
Delaware, Pa.	541.6	533.7	−1.5
Montgomery, Pa.	499.8	514.8	−3.0
Philadelphia, Pa.	1,946.5	1,894.8	−2.7
Burlington, N.J.	195.2	191.4	−0.4
Camden, N.J.	385.9	382.8	−0.8
Gloucester, N.J.	133.7	130.5	−2.4
Total of county estimates	4,206.2	4,147.1	−1.4

[a] Philadelphia Standard Metropolitan Statistical Area

[b] Inclusion of the constant term by adding 28 persons per census tract would lessen the negative bias by about 23,000 persons. The constant term, however, is not statistically significant.

rule of thumb based on conjectural analysis [Relation (1)]; it is

$$P(t) = .89\,P(t\text{-}10) + 4.1\,dH. \qquad (2)$$

An estimator was also derived with respect to change in total housing supply (dTH), which includes vacant units; it is

$$P(t) = .89\,P(t\text{-}10) + 3.92\,dTH. \qquad (3)$$

Another analysis was made distinguishing between major components of the total housing supply. With $dApt$ referring to increments in apartment units (those in structures with five or more units) and dSF referring to increments in single family units (actually, all others), we have

$$P(t) = .90\,P(t\text{-}10) + 3.94\,dSF + 2.68\,dApt. \quad (4)$$

Standard errors for these relations are less than 400 persons, or 7.5 percent of 5,300, the tract average in household population as of 1960. Constant terms were small. Relation 2 was the most precisely defined, having a standard error of about 350 persons with 95 percent of the errors of estimate less than a standard error.

The impression one gains from this type of analysis, as currently applied to Philadelphia, is that the city's population is now between 1.85 and 1.95 million, some 5 percent down from 1960's population of 2.002 million. School enrollment data indicate a gain of about 20,000 households (by 1970) whereas about 50,000 would be necessary to stabilize the population total. Other estimates of current population that I am familiar with indicate small gains for the city since 1960. The special census of Manhattan in 1957 proved that a large city can lose tens of thousands of people a year without anyone being very much aware of the change on a day-to-day basis. I suspect the same sort of thing has happened in Philadelphia since 1960.

One final table may be of particular interest to statistical geographers. Relation 2 was applied to data for counties in the Philadelphia SMSA with the results listed in Table 4. The results are reasonably accurate even for Philadelphia, whose census tracts were excluded from the regression analysis which established Relation 2. The item of interest is that the fine-grained analysis seems pertinent to coarse-grained data, a condition not necessarily expected. It is common for statistical findings to depend critically on the physical extent of the areal units sampled.[6]

Suggestions

Perhaps all that can be said at this time is that the statistical analysis inspired by Reams' observations seems to have been justified and that the conjectural analysis has not been disproved.

Without going into an extended discussion of statistical findings, it can be noted that the results have been derived by multiple linear regression analysis and that all the coefficients listed are of very high statistical significance. In addition, constant terms are small, as are standard errors; residuals are well distributed according to normal expectations.

The data have been drawn from slums, rural hinterland, and all types of areas inbetween, and include the large cities of Camden, New Jersey, and Chester, Pennsylvania. The population in the set of census tracts totaled well over two million.

It is suggested that if estimates of current population are far out of line with application of these formulae, it may be desirable to consider the results only as indicative of a range of uncertainty. Unfortunately, there can be no guarantee that Pennsylvania's experience during the 1950's is appropriate to conditions in the 1960's. An important development of the 1960's has been the heightening of social tensions in many central cities. If such tensions have increased the mobility of mature families, persistence rates may well have been lowered in some areas with a concomitant rise in the size of marginal families in other areas.

NOTES

1 Meyer Zitter and Henry S. Shryock. "Accuracy of Methods of Preparing Postcensal Population Estimates for States and Local Areas," *Demography*, I, No. 1 (1964), 237 and Table 8.

2 Warren S. Thompson and David T. Lewis, *Population Problems* (Fifth Ed., New York: McGraw-Hill, 1965), p. 10.

3 Janet Abu-Lughod and Mary Mix Foley, "Consumer Strategies," Part II of Nelson Foote, *et al., Housing Choices and Housing Constraints* (New York: McGraw-Hill, 1960), Table 19, p. 99 and p. 100 (footnote).

4 Ned Shilling, "Net Household Formation—A Demographic Analysis" (unpublished Master's essay, Columbia University, 1955), cited by Louis Winnick, *American Housing and Its Use* (New York: Wiley and Sons, 1957), p. 81.

5 U.S., Bureau of the Census, Current Population Report, P-20, No. 175 (June 25, 1968), Tables 1 and 5.

6 See, Duncan, Cuzzort, and Duncan, *Statistical Geography, Problems in Analyzing Areal Data* (Glencoe, Illinois: Free Press, 1961).